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EDITED BY

THOMAS L. STEDMAN, M.D.
NEW YORK CITY

IN TWENTY VOLUMES

VOLUME I.

DISEASES OF THE UROPOIETIC SYSTEM

NEW YORK
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1895

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PREFACE.

To those who realize the many and radical changes that have taken place in the healing art during the closing years of this century no apology is needed for the work here presented. Within but little over a decade a new science has arisen and a new theory of infectious diseases has been established, while the advances made in many other branches of internal medicine have been hardly less remarkable. Indeed it is not too much to say that a new era has begun, one in which the rational treatment of disease engages the best thought of the best workers, supplementing, while not supplanting, the study of pathological anatomy by which the preceding era was characterized. The science of medicine has been in great part recast—the time is now ripe for it to be rewritten. To this end the co-operation of many recognized authorities in Europe and America has been secured, the results of whose labors will be presented in the successive volumes of this series.

In arranging the order of subjects it has been thought best to reserve the consideration of infectious diseases for the later volumes, in the hope that by the time they are published a solution of some of the problems in the pathogenesis and therapy of these affections, as yet but partially worked out, will have been reached. While the published schema of the work will be as far as possible adhered to, circumstances may compel a rearrangement of the articles, or even a change in the order of publication of the volumes. Such changes will not, however, affect the completed work.

The editor gladly embraces this opportunity to express his grateful appreciation of the kindly readiness with which the collaborators have responded to his invitation to assist in the work. To the publishers are due his thanks for the uniform courtesy, generous acquiescence, and helpful suggestion, which have contributed in no small measures to lighten his labors. It is his pleasant duty also to acknowledge his indebtedness for valued counsel to Drs. Bulkley,

Dana, and Shrady, of New York, Prosser James, of London, and von Noorden, of Frankfort o. M. To Dr. Albert H. Buck especially is he under deep obligation not only for advice and encouragement in the present undertaking, but also for many kindnesses of a like nature in the past.

T. L. S.

New York, January 30, 1895.

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DISEASES OF THE KIDNEYS.

BY

FRANCIS DELAFIELD,

NEW YORK.

DISEASES OF THE KIDNEYS.

THE kidneys are deeply seated in the lumbar region, lying one on each side of the vertebral column, behind the peritoneum. They measure about 4 inches in length, 2½ inches in breadth, and 1¼ inch or more in thickness. The left is usually longer and narrower than the right. The weight of each kidney is usually stated to be about 4½ ounces in the male, and somewhat less in the female.

It is exceedingly difficult to reach any certain results by percussion as to the size, or even as to the presence, of the kidneys. Auscultatory percussion is much more valuable for this purpose than is simple percussion. Palpation is used with the patient lying on his back. Any considerable enlargement or displacement of the kidney can be made out in this way.

Each kidney is enclosed in a connective-tissue capsule, the blood-vessels of which are continuous with those of the cortex. In healthy kidneys, when the capsules are stripped off the surfaces of the kidneys are left smooth except at the points where the blood-vessels are broken off. If, however, there has existed a nephritis which has involved the stroma of the kidney, when the capsule is stripped off the surface is left torn and roughened.

The kidneys are composed of two portions—the cortical, which performs the excreting functions of the kidney, and the pyramidal, which conveys the urine to the calyces. Their component parts are: the uriniferous tubes, blood-vessels, glomeruli, lymphatics, and stroma.

Each uriniferous tube begins in a glomerulus at some point in the cortex of the kidney. The tube is at first of large size, is arranged in convolutions, and is lined with large epithelial cells which are closely joined together, have a thin and fragile limiting membrane and a cell body which is easily changed by preservative fluids. As the tube approaches the pyramidal portion of the kidney its course becomes straighter and its calibre smaller, it runs down into the pyramid for a considerable distance, then turns upon itself, forming a loop (Henle's loop), and goes back into the cortex. The loop portion of the tubes is lined with flattened cells having an oval, bulging nucleus. After the tube has again reached the cortex it becomes

larger, runs in a straight line nearly up to the surface of the kidney, and is lined with large epithelial cells of which the limiting membranes are more distinct and the cell bodies more resistant than is the case in the convoluted tubes. Now the tube again becomes convoluted for a short distance, then runs a straight course down through the cortex into the pyramid. In the pyramid it joins one of the large collecting tubes and so finally reaches its outlet into a calyx. The tubes in the pyramids are lined with large epithelial cells, having a very distinct limiting cell membrane and very resistant cell bodies.

The renal arteries are large in proportion to the size of the kidneys. Each artery divides into four or five branches which pass in at the hilus, penetrate the substance of the organ between the papillæ, enter the cortex between the pyramids, subdividing, until they reach the bases of the pyramids where they form arches. From these are given off small arteries which run straight up into the cortex, and from these arteries are given off the little branches to the glomeruli.

The efferent veins from the glomeruli are continuous with a system of capillaries surrounding the cortex tubes which empty into veins running parallel with the straight arteries in the cortex. There are also many veins and venous capillaries in the pyramids. All empty into the large renal vein which joins the inferior vena cava.

The glomeruli are formed of a capsule and an enclosed tuft of small blood-vessels. The capsule is continuous with the basement substance of a uriniferous tube, and is lined with a continuous layer of flat endothelial cells. The tuft is composed of vessels of capillary size, but with rather thick walls. Their endothelial lining does not seem to be continuous as it is in most capillaries. Their outer surfaces are covered with a continuous layer of flat, nucleated cells.

The cortical portion is composed of bundles of straight tubes and of convoluted tubes and glomeruli, alternating with each other. The stroma is delicate and scanty in the cortex, firmer and more abundant in the pyramids. In most adult kidneys there are little areas of connective tissue scattered in the cortex close under the capsules. The lymphatics are numerous, and consist of a superficial and a deep set.

It is the function of the kidneys to remove from the body fluid and excrementitious substances. It is generally believed that the fluid is discharged by the glomeruli, and the excrementitious substances separated from the blood by the epithelium of the cortex tubes.

It is evident that for the proper performance of the functions of the kidneys there must be: (1) A free supply of blood to the kidney, a free circulation of blood through it, and an easy escape of blood through the renal vein. Any obstruction to the flow of blood, any changes in the tufts of the glomeruli, and any obliteration of the

capillaries interfere with the functions of the kidneys. (2) The blood supplied to the kidney must be of normal composition; otherwise there will be a change in the character and quantity of the substances excreted. (3) The uriniferous tubules must be of normal size and unobstructed. The epithelial cells which line them must be healthy.

The study of the diseases of the kidney is, therefore, a study of the changes in the circulation of the blood in these organs, of the composition of the blood which is supplied to them, and of anatomical changes affecting the tubes, the stroma, the glomeruli and the blood-vessels.

Classification of Diseases of the Kidney.

The recognition of the diseases of the kidney, which still bear the name of their discoverer, dates back only to the year 1827, when Richard Bright published his first paper on the subject. This first paper was followed by others, and in 1829 Christison published in the *Edinburgh Medical and Surgical Review* his account of the same disease. Both these authors regarded the disease as a morbid change in the kidneys, which was the cause of the accompanying symptoms.

In 1841 Rayer completed his large atlas of colored plates and description of kidney diseases. His classification is as follows:

1. Nephritis—an inflammation of the cortical or tubular portion of the kidneys: (*a*) Simple nephritis; (*b*) Gouty nephritis; (*c*) Rheumatic nephritis; (*d*) Nephritis produced by poison; (*e*) Albuminous nephritis;

2. Pyelitis;

3. Perinephritis.

In 1842 Rokitansky recognized the waxy, or amyloid, kidneys as presenting different lesions from those found in other examples of kidney disease.

In 1851 Frerichs published his monograph on Bright's disease, and gave a systematic description which has had a decided effect on the minds of most subsequent observers. His conception is that of one disease—Bright's disease, with a characteristic lesion—inflammation of the kidneys. The varieties of the disease depend upon the stages of the inflammation. There are three stages:

1. The stage of hyperæmia and of commencing exudation.

2. The stage of exudation and of commencing transformation of the exudation.

3. The stage of atrophy.

1. *Hyperæmia.*—The first stage is characterized by an increase in the size of the kidneys, especially of the cortex, by general congestion,

by extravasations of blood in the Malpighian bodies, the tubes, and the kidney tissue, and by filling of the tubes with coagulated fibrin. The epithelium of the tubes is unaltered.

2. *Exudation.*—In the second stage, the congestion diminishes while the exudation increases. The exudation is found in the tubules and in the interstitial tissue. The exudation between the tubes is sometimes organized into connective tissue. The cortex becomes of a white-yellowish color, and remains thickened. The surface of the kidney is smooth or slightly granular. The pyramids are of a reddish color. Some of the Malpighian bodies are normal, others are enlarged and filled with exudation. In the cortex the epithelium of the tubes is swollen and granular, and may break down altogether, or it simply shrivels and atrophies. The tubes are filled with degenerated epithelium, granular matter, and fat-globules, or with homogeneous exudation. The tubes are dilated. The dilatation of the tubes is the principal or only cause of the increased size of the kidney.

3. *Atrophy.*—In the third stage, the kidneys are smaller, or of normal size, or even larger than normal. The capsule is adherent. The surface of the kidney is irregular and granular, its color a dusky yellow. Its consistence is hard. The cortex is thinned. The pyramids are smaller. The fat about the pelvis is increased in amount. The tubes are dilated and filled as in the second stage, or are collapsed and folded together. Most of the Malpighian bodies are shrivelled and fatty. If the exudation between the tubes has become organized, we find masses of connective-tissue cells and fibres.

This description of the lesions, taken as it was from nature, is as true now as when it was written. But yet our present pathological knowledge makes us interpret these lesions somewhat differently.

In 1852 Dr. George Johnson published a work on kidney diseases which, like that of Frerichs, has had a durable effect on medical opinions. He distinguishes five forms of Bright's disease.

1. *Acute Desquamative Nephritis.*—The form of disease occurring after scarlet fever, exposure to cold, etc. This corresponds to Frerichs' first stage. Johnson, however, lays most stress upon the desquamation of the epithelium, and but little on the exudation in the tubes. Exudation between the tubes he does not mention.

2. *Chronic Desquamative Nephritis.*—This corresponds to the second and third stages of Frerichs. Johnson describes the degeneration of the epithelium, the denudation of the tubes of their epithelium, their dilatation and collapse, and the presence of coagulated material within them. The Malpighian tufts are thickened or atrophied. The arteries are thickened. He regards the production of new fibrous tissue as an accidental and unessential phenomenon.

3. *Waxy Degeneration of the Kidney.*—Under this name Johnson describes kidneys which are of large size, their cortex thick and white, their tubes filled with waxy material. This waxy material he supposes to be produced by a degeneration of the epithelium. The large hyaline casts found in the urine he calls waxy, and seems to consider them diagnostic of this form of kidney disease.

4. *Acute Non-desquamative Disease of the Kidneys.*—This is characterized during life by scanty or suppressed urine, but containing no albumin, and no casts, or only a few waxy ones. The kidneys are of normal size; the epithelium of the tubes is somewhat altered.

5. *Chronic Non-desquamative Disease.*—The kidneys are usually large, very rarely atrophied. The cortex is thick and white. The convoluted tubes are more opaque than usual. The Malpighian bodies and arteries are thickened.

6. *The Granular Fat Kidney.*—This form may be a consequence of the non-desquamative disease, of acute desquamative inflammation, and rarely of chronic desquamative disease. The kidneys are large, the cortex white, mottled with yellowish granulations. These yellow granulations are formed of tubes containing oil-globules. The vessels and Malpighian bodies are thickened. Sometimes the same yellow, fatty granulations are found in atrophied kidneys.

7. *The Mottled Fat Kidney.*—All the tubes of the cortex contain oil-globules, and there are red spots of congestion or extravasation.

To Traube (1856) belongs the merit of recognizing chronic congestion of the kidney as a lesion with an entirely different cause from that of other forms of Bright's disease; and also of calling attention to the fact that blood-contamination cannot be the only cause of the cerebral symptoms.

In 1858 Virchow, in his "Cellular Pathology," developed the doctrine that in Bright's disease either the tubes, the stroma, or the Malpighian bodies are principally involved, and that we can, therefore, distinguish a parenchymatous nephritis, an interstitial nephritis, and an amyloid degeneration of the kidney. This doctrine has had a lasting effort on all subsequent classifications.

Grainger Stewart distinguishes:

1. *The Inflammatory Form.*—This has three stages: (1) That of inflammation; (2) That of fatty transformation; (3) That of atrophy. These correspond very closely with the three stages described by Frerichs.

2. *The Waxy Form.*—This also has three stages: (1) That of simple degeneration of the vessels; (2) That in which a secondary alteration of the tubes is superadded; and (3) That of atrophy.

In the first stage, the kidney is of normal size, the tubes are un-

altered; only the Malpighian bodies and small arteries have undergone waxy degeneration.

In the second stage, the kidney is enlarged, the cortex thick and white, with Malpighian bodies and small vessels waxy; the tubes contain hyaline casts; their epithelium is swollen; their basement membrane may be waxy.

In the third stage, the kidney is small. The surface is rough, granular, and pale. The tubular structures are swollen. The tufts and vessels are waxy. A few tubes are distended, most are collapsed, and are represented only by fibrous tissues.

3. *The Cirrhotic, or Contracting Form.*—This consists of an hypertrophy of the connective tissue of the organ, and a consequent atrophy of all the other structures.

There is at first little diminution in the size of the organ, but the capsule is thickened and adherent, and the surface is rough and granular. The color is pale and reddish. The arteries are prominent, their walls thickened, and their cavities often dilated. On the surface, and in the substance, cysts are often seen. Some are produced by dilatation of the Malpighian capsules, some by dilatation of the tubes, some by a morbid growth of epithelial elements. The tubes are compressed and atrophied by the new fibrous tissue. They contain little opaque material, but often hyaline matter. Sometimes urate of soda is found in the stroma and tubes of the pyramids. The disease is a non-inflammatory increase of connective tissue.

Both the waxy and contracting forms may be secondarily affected with the inflammatory disease.

4. *Simple Fatty Degeneration.*—The kidneys are of about the normal size. The surface is smooth, the capsule not adherent. Their texture is soft, the cortex is pale and mottled, with sebaceous-looking deposits. The epithelium of the tubes is fatty.

Dickinson describes tubal nephritis, granular degeneration, and depurative infiltration:

1. *Acute Tubal Nephritis.*—This, the nephritis of scarlet fever and of exposure to cold, is described in very much the same terms as the acute desquamative nephritis of Johnson.

2. *Chronic Tubal Nephritis.*—The kidney is large, the cortex of an opaque white or buff-color, the pyramids pink. The surface is smooth, the capsule not adherent. The convoluted tubes are distended with granular and fatty epithelium and with fibrinous exudation. The straight tubes are packed with the products of epithelial growth, while others contain transparent fibrin. The tubes are not changed, save as regards their contents. The Malpighian bodies are normal or somewhat dilated. There is no increase of intertubular

tissue. These kidneys remain large and smooth to the last, unless complicated with the depurative change.

Sometimes the cortex is sprinkled with white, sharply defined specks, like bits of bran. This change is characteristic of a great amount of fatty change in the accumulated epithelium.

3. *Granular Degeneration.*—The kidneys may be of normal or even increased size, but are usually small. The capsule is adherent. The surface is irregular and covered with little rounded nodules. The cortex is thin. Cysts are often found in the cortex and cones. There is an increase of fibrous tissue around the Malpighian bodies and vessels, and beneath the capsule and deeper in the cortex. The cortical tubes are atrophied or dilated, but many tubes may remain unchanged. The tubes may be filled with epithelium, or with transparent, fibrinous material. In the majority of cases the epithelium is exactly such as is found in normal kidneys. When changed, it is by an alteration in its regularity of form, becoming somewhat angular, as if cramped in growing space. The circulation through the blood-vessels is much obstructed. The formation of cysts is due to dilatation of the tubes or of the Malpighian capsules.

4. *Depurative Infiltration.*—The kidney is at first of normal size, pale, and its surface smooth. The only change is in the Malpighian tufts, which react with iodine. As the disease goes on, the kidney becomes larger and its capsule adherent. The cortex is of a pale, opaque fawn color, or has a pinkish or gray translucency. Afterward the kidney atrophies and its surface becomes nodulated. There may be small cysts. In cases of long standing, almost the entire organ gives the characteristic reaction with iodine. The first change is the infiltration of the Malpighian bodies and vessels. Afterward new fibrous tissue is formed between the tubes, the epithelium degenerates, the tubes are dilated and contain fibrinous casts.

It will be seen that the name of "depurative infiltration" is given to the same form of kidney disease which is called by others waxy or amyloid.

Klebs describes:

1. *Diffuse Granular Degeneration of the Epithelium.*—This condition is found by itself, and in connection with lesions in the interstitial tissue. By itself, it occurs with pyæmia, phthisis, rheumatism, typhoid and typhus fevers, the malarial fevers, the acute exanthemata, extensive burns, poisoning with phosphorus and the mineral acids. During life the urine may contain granular casts and albumin. The kidney is somewhat enlarged, the cortex grayish-yellow, the pyramids bluish-red. There may be little extravasations of blood in the convoluted tubes. The epithelium of the tubes is granular and may

distend them. The tubes may contain casts. These changes are most frequent in the convoluted tubes, but are sometimes confined to the straight tubes of the pyramids. The entire process is a degenerative and not an inflammatory one.

2. *Cyanotic Induration of the Kidneys.*—This condition is produced by any long-continued obstruction to the escape of venous blood from the kidneys, most frequently by heart disease. The kidneys are increased in size, the surface is smooth, the capsule not adherent. The organ is hard, the cortex and pyramids are congested and of a dark-red color. The epithelium of the tubes is not altered. The interstitial tissue is harder, but not increased in amount. The continued congestion may, after a time, produce further changes. The epithelium of the convoluted tubes may undergo granular degeneration, and the cortex becomes paler. Or there may be an increase of interstitial tissue, and the surface becomes nodular.

3. *Interstitial Nephritis.*—This has two stages: (*a*) That of cell-infiltration; (*b*) That of atrophy.

(*a*) The Stage of Cellular Infiltration of the Interstitial Connective Tissue.—The kidney is increased in size. The surface is smooth, the capsule not adherent. The cortex is of a whitish or yellowish color, the pyramids are red. In the cortex the tissue between the tubes is everywhere increased from two to four fold. This increase is due to the presence of lymphatic elements and of clear serum. There is at first an exudation of lymphatic fluid, which dilates the lymphatic vessels of the interstitial tissue, and is accompanied by an emigration of white blood-globules, which finally fill all the spaces in the interstitial tissue. The epithelium of the convoluted tubes undergoes granular degeneration in consequence of its disturbed nutrition. The increased pressure of blood causes an exudation of the elements of the blood from the Malpighian tufts, namely, fibrinogenic material which coagulates in the tubes, albumin, and red blood-globules. The lymphatic cells perforate the basement membrane of the tubes, and become adherent to the fibrinous cysts.

(*b*) The Stage of Atrophy.—The preceding stage may terminate in resolution and recovery. If it does not, it is succeeded either by a hyperplasia of connective tissue or by granular atrophy.

If there is a hyperplasia of connective tissue, the kidneys are of normal size, or slightly atrophied. The capsule is somewhat adherent. The cortex is whitish, yellowish, or mottled. The pyramids are congested. There is a uniform increase of connective tissue between the tubes. The tubes are unaltered or somewhat narrowed.

Granular atrophy is more common. The kidney is atrophied. The capsule is very adherent. The surface is uneven and nodular.

The change of the lymphatic cells into connective tissue is accompanied by fatty degeneration of the cells. In the atrophied spots the tubes and glomeruli become impervious. The tubes contain hyaline casts. The basement membrane of the atrophied tubes becomes thick and fibrous. The glomeruli are atrophied, their capsules thickened, their vessels obliterated. The larger arteries are thickened.

Glomerulo-nephritis.—Klebs gives this name to a form of disease which he has observed in scarlatina cases. The kidneys are of medium size, the capsule is not adherent, the surface smooth, the parenchyma congested. There are no changes except in the glomeruli. These appear as opaque, white points. On minute examination, it is found that there are large numbers of small, rounded cells about the loops of the Malpighian tuft, while the epithelium of the capsule is unaltered.

Amyloid degeneration is described in much the same way as by other authors.

Rindfleisch describes:

1. *Acute Parenchymatous Nephritis.*—In the milder form the kidney is of normal size, the surface smooth, the cortex of a yellowish-gray color. There is a moderate degree of cloudy swelling of the epithelium of the convoluted tubes.

In the severer form the kidney has the same appearance, but is increased in size and the cortex is thickened.

Both these forms occur with the acute exanthemata, typhus fever, pyæmia, etc.

2. *Diffuse Interstitial Nephritis.*—This corresponds very closely with the description given by Klebs.

He states that the disease may begin as a parenchymatous nephritis, and afterward become interstitial, but that the two forms also occur independently of each other.

Amyloid degeneration is usually accompanied by interstitial nephritis. The amyloid degeneration is the primary change, and the nephritis follows it as a secondary lesion.

Rosenstein describes:

1. *Chronic Congestion of the Kidney.*—This condition is described in much the same way as by the preceding authors.

2. *Catarrhal Nephritis.*—The kidney is of normal size, or slightly enlarged; in severe cases congested and mottled with small ecchymoses. The process begins at the apices of the pyramids, which are at first congested, afterward pale. After a time we find the pyramids divided into red and white striæ, running from the apex to the base of the pyramids. The red striæ are the portions more recently congested; the white are the tubes distended by an increase of epithelium.

The urine contains a little albumin, hyaline, granular, and epithelial casts and blood-globules.

The symptoms during life are not marked. The lesion is seldom primary. It may follow catarrhal inflammation of the urethra, bladder, or ureters; the use of cantharides, copaiba, or cubebs; typhoid or typhus fever, cholera, etc.

3. *Diffuse Nephritis, Parenchymatous Nephritis, Bright's Disease, Granular Degeneration of the Kidney.*—This form has three stages.

The first stage is that of hyperæmia. The kidney is of normal size, or enlarged, congested, and red; there is blood in the tubes, and the epithelium of the convoluted tubes is swollen.

The second stage is that of exudation. The kidney is enlarged, the cortex pale, the pyramids red. The epithelium of the convoluted tubes is swollen and granular. The tubes are dilated and contain casts. There is usually an increase of cells in the interstitial tissue.

The third stage is that of atrophy. The kidney becomes smaller, its surface nodular. The atrophy may take place without any change in the interstitial tissue, simply as a result of the destruction of the epithelium. Usually, however, the retraction of the new interstitial tissue assists in producing the atrophy.

The epithelium is granular or fatty. The Malpighian bodies are atrophied, their capsules thickened and surrounded with new connective tissue. The basement membranes of the tubes are thickened, and are accompanied by bands of connective tissue. The intertubular capillaries are partly dilated, partly small and fatty.

The atrophy consists, therefore, in a suppression of the function of a number of the tubes, with obliteration of some of the blood-vessels and increase of the interstitial tissue.

Either process, that in the epithelium or that in the connective tissue, can occur separately, but they are usually combined.

4. *Amyloid Degeneration.*—Rosenstein describes this form in much the same way as other authors. He regards the degeneration of the vessels only as a complication of the parenchymatous and interstitial change.

5. *The Fatty Kidney.*—There is an infiltration of the epithelium with fat, or a fatty degeneration. The condition is described in the same way as the diffuse granular degeneration of Klebs.

Weigert divides Bright's disease into parenchymatous degeneration and true nephritis. He does not distinguish between interstitial and parenchymatous forms of nephritis, but believes that in all cases the disease begins with degeneration of the epithelium, which is followed by inflammatory interstitial processes.

Gull and Sutton have shown very clearly the frequency with which

changes in the arteries and capillaries—arterio-capillary fibrosis—are associated with the atrophic form of Bright's disease; and that these changes in the arteries and capillaries may also exist and give symptoms without any lesions of the kidneys. From these facts they have drawn the conclusion that this form of Bright's disease is not, properly speaking, a disease of the kidneys, but rather one of the arteries and capillaries.

Bartels uses the name of "The Diffuse Diseases of the Kidneys," with the subdivisions of Hyperæmia, Ischæmia, Acute Parenchymatous Nephritis, Chronic Parenchymatous Nephritis, Renal Cirrhosis, and Amyloid Degeneration.

Active hyperæmia is, he says, a condition which arises solely as the result of some toxic influence, most frequently from the use of cantharides. Apparently he has little or no personal experience of the anatomical changes found in the kidneys.

Passive hyperæmia is the same condition as that called also chronic congestion of the kidney, and cyanotic induration of the kidney. Its most important form is that due to valvular lesions of the heart and to certain affections of the lungs. He makes no new statements concerning the pathological changes.

Ischæmia is the condition of more or less complete stoppage of the arterial blood-supply to the kidneys, occurring independently of congestion of the nervous system. It occurs only in the asphyxia stage of cholera.

Acute Parenchymatous Nephritis.—Under this name Bartels includes all the cases of acute Bright's disease. He says that the only essential and constant microscopical appearances are the changes in the epithelium of the tubes. The epithelial cells are swollen and cloudy, they are infiltrated with granules of fat, and are broken down. To these changes in the epithelium are frequently added a swelling and infiltration of the stroma, casts in the tubes, and extravasations of blood.

Chronic Parenchymatous Nephritis.—This may follow acute parenchymatous inflammation or may begin as a chronic process. The kidneys are large, white, and smooth. The tubes are dilated; the epithelium is only partly preserved, and the cells which remain are large, granular, and fatty. In many places the epithelium is completely gone and in its stead the tubes are entirely filled with masses of detritus mixed with oil-globules; casts are found in many of the tubes. The stroma is thickened by fluid exudation, by an emigration of white blood-cells, and by a growth of new connective tissue. The small arteries and Malpighian tufts are often the seat of waxy degeneration.

Renal Cirrhosis.—The kidney is very much diminished in size, especially the cortex. This diminution in size is due to the wasting of the glandular tissue, while at the same time there is an extensive growth of new fibrous tissue. The change in the kidney is due to a primary growth of the intertubular connective tissue, and this leads to the dwindling of the substance of the gland, a wasting preceded by no inflammatory swelling of the organ.

To Cohnheim belongs the merit of drawing attention to the importance of the glomeruli in acute nephritis, and to the changes which are found in them. He also points out clearly that well-marked symptoms of acute nephritis may exist during life, although no structural changes are found in the kidneys after death.

Langhans, Nauwerck, and Friedländer have developed still further the doctrine of glomerulo-nephritis, and have described in detail the lesions found in the glomeruli.

Ziegler describes:

1. *Glomerulo-nephritis*, occurring either by itself or combined with changes in the epithelium of the tubes or with exudation of inflammatory products into the stroma.

2. *Chronic Parenchymatous Nephritis.*—The common feature of this form of nephritis is that there is a continuous inflammatory exudation from the blood-vessels, and that changes go on in the epithelium of the kidney.

As subdivisions of parenchymatous nephritis he distinguishes:

The inflammatory, fatty kidney;

Chronic hemorrhagic nephritis;

Chronic glomerulo-nephritis.

3. *Chronic Indurative Nephritis.*—The inflammation leads to a new growth of connective tissue in the stroma, and an atrophy of the tubes and the glomeruli.

4. *The Arterio-sclerotic Contracted Kidney.*—In this the changes begin in the walls of the arteries; they are thickened, their lumen is narrowed or obliterated. As a result, smaller or larger numbers of glomeruli become atrophied, with the kidney tissue belonging to them. The stroma is not much thickened.

Cornil remarks that the expression of Bright's disease applied to the kidney has nowadays no more value than the expression of dyspepsia applied to the pathology of the stomach or of asystolie applied to the pathology of the heart. He distinguishes:

1. *Granular alteration of the renal epithelium*,—a common lesion found in different forms of hyperæmia, especially in those symptomatic of the infectious diseases.

2. *Fatty degeneration*, which is secondary to the chronic diseases.

3. *Chronic congestion of the kidney*, due to mechanical disturbances of the circulation.

4. *Diffuse nephritis*, in which all the anatomical elements of the kidney are involved.

(*a*) Acute nephritis with predominance of congestive and inflammatory phenomena.

(*b*) Acute nephritis with predominance of diapedesis.

(*c*) Acute nephritis with predominance of degenerative lesions.

(*d*) Nephritis with predominance of the lesions of the glomeruli.

(*e*) Nephritis with predominance of lesions of the epithelium.

(*f*) Nephritis with predominance of lesions of the stroma.

5. *Systematic nephritis*, in which from the first the lesion involves exclusively one of the elements of the kidney.

(*a*) Epithelial cirrhosis of the kidney. A chronic degeneration of the renal epithelium with atrophy of certain systems of tubes and glomeruli.

(*b*) Vascular cirrhosis—a true interstitial inflammation of the kidney with endarteritis of the renal arteries.

All of Cornil's anatomical descriptions are very true to nature, but his classification is not one adapted to clinical purposes.

As we look back over the history of the disease, it is easy to recognize the points of difference and the progress which has been made.

From the very first we find authors looking at the disease from two points of view: that of the symptoms and that of the lesions. So that, while some regard Bright's disease as a nephritis with its attendant symptoms, others regard it as a disease of the blood, or of the arteries and capillaries, with which a nephritis may or may not be associated.

At the time when Frerichs wrote, it was customary to regard a great many morbid conditions as of an inflammatory character, and to think that every inflammation went regularly through three stages. So we find Frerichs arranging all the lesions of Bright's disease as belonging to the stages of congestion, exudation, and contraction of a nephritis, and teaching that all the forms of acute and chronic Bright's disease were different stages of one and the same morbid process.

Then we find in England, first Johnson, and then Dickinson, referring most of the kidney lesions to changes in the epithelium of the tubes. Here, again, it soon became evident, that although changes in the epithelium exist and are of importance, yet Johnson and his school had taken too one-sided a view of the subject.

That in some cases of Bright's disease there is waxy degeneration

of the walls of the arteries and Malpighian tufts was early recognized by Rokitansky. As these kidneys have been more studied, it has been found that there may be:

1. Waxy degeneration of the arteries and glomeruli, without any change in the other parts of the kidneys or any disturbance of its functions.

2. Waxy degeneration of the arteries and tufts, followed by chronic changes in the rest of the kidneys.

3. Waxy degeneration of the arteries and tufts, forming an unimportant part of a chronic nephritis.

The next step forward was the recognition by Traube of the condition of chronic congestion of the kidney, its dependence on heart disease, and its termination in changes in the structure of the kidney.

Then we find an attempt by Grainger Stewart to go back to Frerichs' classification of an inflammation in three stages, but separating the waxy and the cirrhotic kidneys.

Among English writers we find a disposition to class the kidneys according to their gross appearance, and to speak of the large white kidney and the contracted kidney, and to regard the cirrhotic kidney as not inflammatory. In England, also, we find especial attention drawn to the condition of the arteries and capillaries in the kidneys and in the rest of the body as a cause of the kidney lesions and of the symptoms.

The next step forward was the recognition of the changes in the glomeruli, first by Klebs, then by Cohnheim, Friedländer, and others.

At the same time there has been an attempt, especially in Germany, to class together the changes in the epithelium, the exudation of inflammatory products, and the formation of new connective tissue under the one head of parenchymatous inflammation, teaching that the morbid process originates in the epithelium, and that the other changes are secondary to this.

Further modifications have been introduced into this doctrine of parenchymatous nephritis by the contention that changes in the epithelium alone are not of inflammatory, but of degenerative, nature. Incidentally Cohnheim brings out well the important point that with well-marked changes in the urine and constitutional symptoms we may find no structural changes in the kidneys; in other words, that the morbid changes in these kidneys must have been confined to the blood-vessels.

With Ziegler, Cornil, and others have come in an improved technique and an exact study of the changes in the kidney, which have given us a much more satisfactory knowledge of the lesions.

Although so much has been done in the study of the lesions of

Bright's disease, it must be confessed that the ideas of the profession in general concerning it are still somewhat crude.

As regards acute Bright's disease, we often find the belief:

That the kidneys are large, and either white or congested; that the chief change is in the epithelium of the tubes, which is swollen and detached and blocks up the tubes; that there is some change in the glomeruli which allows albumin to pass through the walls of the capillaries; that the patients pass too little urine; that in consequence of this diminished production of urine there may be developed dropsy or cerebral symptoms; that the chief object of treatment is to make them pass more urine, or, failing this, to purge or sweat them.

As regards chronic Bright's disease, it is generally believed that there are two principal forms: one, in which the kidney is more or less large and white, while during life there is dropsy, and much albumin in the urine; and one in which the kidney is more or less contracted and red, and there is little or no albumin in the urine, and little or no dropsy.

It has become evident to many careful observers that there is a group of persons who are more liable than are others to chronic productive inflammation in different parts of the body. It may be the lungs, or the heart, or the arteries, or the liver, or the kidneys that are affected; and either one or several of these organs are involved at the same time.

The liability is most common after forty-five years of age, but is by no means infrequent in younger persons. Unquestionably many of these persons are gouty; in some there is a history of chronic alcoholism; in some there is an hereditary history; many of them suffer from disturbances of digestion; many of them have habitually an excess of urates, or oxalates, or occasional sugar, or albumin in the urine.

So great is the number of these cases, and so constantly are these persons under our observation, that it is often not difficult to recognize that an individual belongs to this group before he has developed any one of the characteristic inflammations. We can predict beforehand that a given individual will, at some time, develop emphysema, or chronic endocarditis, or endarteritis, or cirrhosis of the liver, or chronic nephritis.

Curiously enough it has occurred to some very intelligent physicians that persons in this group are really all suffering from the same disease, and that they develop the characteristic lesions as the result of the disease. They propose to call this disease Bright's disease. According to this view a person can have Bright's disease while the kidneys are still normal. In this way have come in the terms of

distend them. The tubes may contain casts. These changes are most frequent in the convoluted tubes, but are sometimes confined to the straight tubes of the pyramids. The entire process is a degenerative and not an inflammatory one.

2. *Cyanotic Induration of the Kidneys.*—This condition is produced by any long-continued obstruction to the escape of venous blood from the kidneys, most frequently by heart disease. The kidneys are increased in size, the surface is smooth, the capsule not adherent. The organ is hard, the cortex and pyramids are congested and of a dark-red color. The epithelium of the tubes is not altered. The interstitial tissue is harder, but not increased in amount. The continued congestion may, after a time, produce further changes. The epithelium of the convoluted tubes may undergo granular degeneration, and the cortex becomes paler. Or there may be an increase of interstitial tissue, and the surface becomes nodular.

3. *Interstitial Nephritis.*—This has two stages: (*a*) That of cell-infiltration; (*b*) That of atrophy.

(*a*) The Stage of Cellular Infiltration of the Interstitial Connective Tissue.—The kidney is increased in size. The surface is smooth, the capsule not adherent. The cortex is of a whitish or yellowish color, the pyramids are red. In the cortex the tissue between the tubes is everywhere increased from two to four fold. This increase is due to the presence of lymphatic elements and of clear serum. There is at first an exudation of lymphatic fluid, which dilates the lymphatic vessels of the interstitial tissue, and is accompanied by an emigration of white blood-globules, which finally fill all the spaces in the interstitial tissue. The epithelium of the convoluted tubes undergoes granular degeneration in consequence of its disturbed nutrition. The increased pressure of blood causes an exudation of the elements of the blood from the Malpighian tufts, namely, fibrinogenic material which coagulates in the tubes, albumin, and red blood-globules. The lymphatic cells perforate the basement membrane of the tubes, and become adherent to the fibrinous cysts.

(*b*) The Stage of Atrophy.—The preceding stage may terminate in resolution and recovery. If it does not, it is succeeded either by a hyperplasia of connective tissue or by granular atrophy.

If there is a hyperplasia of connective tissue, the kidneys are of normal size, or slightly atrophied. The capsule is somewhat adherent. The cortex is whitish, yellowish, or mottled. The pyramids are congested. There is a uniform increase of connective tissue between the tubes. The tubes are unaltered or somewhat narrowed.

Granular atrophy is more common. The kidney is atrophied. The capsule is very adherent. The surface is uneven and nodular.

To classify kidney diseases according to the part of the kidney principally involved is very natural and not at all difficult. There can be no question that disease of the epithelium, of the glomeruli, of the stroma, or of the arteries decidedly predominates in different sets of kidneys. A classification on this basis is anatomically correct. But when we try to use this classification for clinical purposes it does not answer. The history which I have already given of anatomical classifications shows this only too plainly. A classification according to the nature of the morbid process is altogether the most promising. There are three morbid processes which occur in nearly every part of the body, which produce definite anatomical changes, cause regular clinical symptoms, and call for appropriate methods of treatment. These morbid processes are congestion, degeneration, and inflammation.

Congestion, whether acute or chronic, produces an accumulation of blood in the veins and capillaries of the part affected, causes local symptoms and disturbances of function, and is to be relieved by means addressed to the circulation of the blood.

Degeneration, whether acute or chronic, produces changes more or less profound in the parts affected; is regularly caused by poisons, by disturbances of circulation, and by other diseases; produces disturbances of function according to its severity; may be itself a cause of inflammation, and can be but little affected by treatment.

Inflammation is attended with three essential features, which may occur separately or together: an escape of the elements of the blood from the vessels, a formation of new tissue, and a death of tissue. So we speak of exudative, productive, and necrotic inflammations.

(*a*) Exudative inflammation is of short duration, leaves behind it no permanent changes in the parts affected, is sometimes accompanied by the growth of pathogenic bacteria, and can be favorably affected by treatment.

(*b*) Productive inflammation runs an acute, subacute, or chronic course. It effects permanent changes in the inflamed parts. Its acute forms are very apt to become chronic. There is much variety as to the relative quantity of exudation and of new tissue. Pathogenic micro-organisms may be present.

(*c*) Necrotic inflammation is characterized by the addition of death of tissue to an inflammation of either exudative or productive type. It is always accompanied by the growth of pathogenic bacteria.

Applying this principle of classification to the kidneys we can distinguish:

1. Acute congestion of the kidney.
2. Chronic congestion of the kidney.

The urine contains a little albumin, hyaline, granular, and epithelial casts and blood-globules.

The symptoms during life are not marked. The lesion is seldom primary. It may follow catarrhal inflammation of the urethra, bladder, or ureters; the use of cantharides, copaiba, or cubebs; typhoid or typhus fever, cholera, etc.

3. *Diffuse Nephritis, Parenchymatous Nephritis, Bright's Disease, Granular Degeneration of the Kidney.*—This form has three stages.

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The epithelium is granular or fatty. The Malpighian bodies are atrophied, their capsules thickened and surrounded with new connective tissue. The basement membranes of the tubes are thickened, and are accompanied by bands of connective tissue. The intertubular capillaries are partly dilated, partly small and fatty.

The atrophy consists, therefore, in a suppression of the function of a number of the tubes, with obliteration of some of the blood-vessels and increase of the interstitial tissue.

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changes in the arteries and capillaries—arterio-capillary fibrosis—are associated with the atrophic form of Bright's disease; and that these changes in the arteries and capillaries may also exist and give symptoms without any lesions of the kidneys. From these facts they have drawn the conclusion that this form of Bright's disease is not, properly speaking, a disease of the kidneys, but rather one of the arteries and capillaries.

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Chronic Parenchymatous Nephritis.—This may follow acute parenchymatous inflammation or may begin as a chronic process. The kidneys are large, white, and smooth. The tubes are dilated; the epithelium is only partly preserved, and the cells which remain are large, granular, and fatty. In many places the epithelium is completely gone and in its stead the tubes are entirely filled with masses of detritus mixed with oil-globules; casts are found in many of the tubes. The stroma is thickened by fluid exudation, by an emigration of white blood-cells, and by a growth of new connective tissue. The small arteries and Malpighian tufts are often the seat of waxy degeneration.

Urates, Oxalates, and Phosphates.—The presence of an excess of uric acid, of the urates, of oxalate of lime, and of the phosphates is of importance, not because it indicates disease or disturbance of functions of the kidneys, but because it shows disordered digestion and an abnormal condition of the blood. There are many cases of kidney disease in which the treatment of these disturbances is of the greatest importance.

Blood.—Hæmaturia is an evidence of bleeding from some part of the genito-urinary tract. So far as the kidneys are concerned the blood comes from their pelves, or from the kidneys themselves. Bleeding from the pelvis occurs with pyelitis, with calculi in the pelvis, and with new growths of the pelvis. Bleeding from the kidney itself is found with acute nephritis, with exacerbations of chronic nephritis, with tubercular nephritis, with the hemorrhagic forms of the infectious diseases, and with malignant growths.

Hæmoglobinuria.—There are morbid conditions in which a considerable number of red blood cells are suddenly killed and the coloring-matter set free in the blood. This is followed by a discharge of this coloring-matter, with a considerable transudation of blood serum from the kidneys, in the urine. We find then a good deal of albumin and of red coloring-matter in the urine, but no red blood cells.

Casts.—There has been some difference of opinion as to the mode of formation of the little cylindrical bodies which are found in the urine and in the kidney tubules. The question has been whether they are all formed of substances coagulated from the blood plasma, or whether some are formed of substances derived from the renal epithelium. Certainly most of them are formed from the blood plasma. They are composed of a transparent, homogeneous matter with which may be mixed renal epithelium, white and red blood-cells, and the granular matter, fat, and nuclei derived from degenerated epithelium. The presence of casts in the urine means, therefore, that there has been an exudation of blood serum into the kidney tubules and more or less degeneration of the renal epithelium. The number of casts in the urine is usually an indication of the number formed in the kidneys, but not always; we may find but few casts in the urine during life and yet after death the kidneys are seen to contain a large number. Albumin and casts are usually present in proportionate quantities: if there is much albumin there are generally many casts, but albumin may be present in large quantities with very few casts. The centrifugal machines which are now in use are of great assistance in looking for casts.

Any one who wishes to understand casts and their mode of forma-

tion must look at them in kidney sections, as well as in the urine. It seems hardly necessary to warn against confounding cylindrical strings of mucus formed in the bladder, often having crystals imbedded in them, with casts formed in the kidney tubules, but the mistake is sometimes made.

Hyaline casts in small numbers, like albumin in small quantities, are occasionally present without disease of the kidneys.

Acute congestion of the kidneys often gives hyaline casts, sometimes granular and nucleated casts.

Chronic congestion gives a few hyaline casts.

Acute degeneration gives casts according to its severity—hyaline casts only, or granular and nucleated casts, or epithelial and blood casts.

Chronic degeneration gives only a few hyaline casts, or none at all.

Acute exudative and acute diffuse nephritis give many casts of every kind.

Chronic nephritis with exudation gives many casts of all kinds, their number being much increased when there is an exacerbation of the nephritis.

Chronic nephritis without exudation gives a few hyaline casts or none at all.

Albumin.—(See page 26.)

Dropsy.

The association of dropsy with kidney disease is of such frequent occurrence that it is often difficult to convince both patients and physicians that "Bright's disease" can exist when dropsy is absent.

If we go through the list of diseases of the kidney we find that their association with dropsy is as follows:

Acute congestion of the kidney—no dropsy.

Chronic congestion of the kidney—dropsy according to the condition of the heart.

Acute and chronic degeneration of the kidney—no dropsy.

Acute exudative nephritis—subcutaneous dropsy, most frequent with nephritis caused by scarlet fever, or by exposure to cold. A similar subcutaneous œdema can be produced by scarlet fever or by exposure to cold without nephritis.

Acute productive (or diffuse) nephritis—both subcutaneous dropsy and dropsy of the serous cavities.

Chronic nephritis with exudation—dropsy of the subcutaneous connective tissue and of the serous cavities in nearly every case.

Chronic nephritis without exudation—no dropsy until late in the disease unless from complicating lesions.

Suppression of urine from obstruction of the ureters—no dropsy.

The primitive explanation of renal dropsy was that fluids accumulated in the body because the patient passed too little water. This seemed satisfactory even to so good an observer as Bartels. It has always had its effect on therapeutics; the rule has been, if a patient has dropsy make him pass more urine. This explanation, however, is in constant contradiction with clinical experience.

The present condition of our knowledge on this subject may be stated somewhat as follows:

1. All dropsies are due to an increased transudation of blood serum from the capillaries and a diminished absorption by the lymphatics. The increased transudation is the more important part of the process.

2. Inflammatory dropsies (or exudations) and passive dropsies may be produced in one of two ways:

(*a*) The capillaries act as filters. The blood serum within them follows the laws of exosmosis. Either increased pressure or a change in the composition of the serum can cause an increased transudation through the walls of the capillaries.

(*b*) The capillaries with their endothelium act as glands and secrete serum. Changes in the composition of the blood or irritating substances in the surrounding tissues can irritate the endothelium and cause increased secretion.

Following these rules the probable explanations of renal dropsies are:

1. *In acute exudative nephritis* the dropsy is due to inflammatory changes in the skin. The dropsy is regularly confined to the subcutaneous connective tissue, and is especially frequent when the nephritis is caused by scarlet fever, or by exposure to cold.

2. *In acute productive nephritis* and in chronic nephritis with exudation the dropsy involves both the subcutaneous connective tissue and the serous cavities. It may be due to irritating substances in the blood, to changes in the composition of the blood, or to changes in blood pressure.

3. *In chronic nephritis* without exudation, the dropsy which comes on late in the disease is caused by changes in blood pressure due to heart failure.

Scattered through medical literature are reports of cases of general subcutaneous dropsy coming on suddenly, lasting for a short time, without any evidence of renal or other disease, and terminating in recovery. Traube thinks that such dropsies are due to a disturb-

ance of the functions of the skin caused by exposure to the weather, but this explanation will not answer for all the cases. In some patients (Taylor, *Medical Times and Gazette*, 1871) the dropsy was preceded by a well-marked febrile movement. I know of only one case of this kind which terminated fatally. It is reported by Wernicke (*Deutsches Archiv für klinische Medicin*, VI., 622). The patient, a girl twenty-two years old, died apparently from the dropsy, and the autopsy showed no lesion to account for the symptoms. The following case is an example of this form of dropsy:

Male, 26, admitted to the Roosevelt Hospital on April 17th, 1884. He had been perfectly well and working hard until two months ago. Then he began to have cough, mucous sputa, and wheezing breathing. One month ago he developed general subcutaneous œdema; the urine was somewhat diminished in quantity, but the man did not feel sick. When admitted to the hospital his pulse was 96, temperature 98° F., respiration 30. There was very marked general subcutaneous œdema. The skin and mucous membranes were rather pale, but the man was well-nourished and did not feel at all sick. A soft systolic murmur could be heard at the apex and base of the heart; the action of the heart was somewhat intermittent and irregular. The dropsy increased for a few days and then gradually diminished. The record of the urine was as follows:

Date.	Quantity in Ounces.	Albumin.	Specific Gravity.	Urea in grains.
April 19	68	None	1024	608
" 20	42	Trace	1012	...
" 21	96	"	1022	340
" 22	150	"	1010	351
" 23	130	"	1026	280
" 24	84	"	1008	479
" 25	132	None	1014	672
" 26	136	"	1012	858
" 27	62	"	1014	410
" 28	44	Trace	1016	394
" 29	45	None	1014	...
" 30	...	"	1016	...

By May 1st the dropsy had entirely disappeared and the man was apparently well.

I have seen a number of hospital patients, who unquestionably had kidney disease, but who had attacks of subcutanous œdema after exposure, apparently not connected with their kidney disease, but caused by inflammation of the skin.

The ordinary treatment of dropsy is directed to the removal of the serum after it has transuded from the vessels. We try to get rid of the dropsy by sweating, by diuresis, or by purging. It is evident

that a much more satisfactory treatment would be to prevent the transudation. If we could find remedies to destroy the irritating substances in the blood and tissues which cause the blood serum to transude, we would be able to prevent the dropsy instead of having to get rid of it.

Albuminuria.

Since the time of Richard Bright the presence of albumin in the urine has been regarded as a proof of kidney disease both by physicians and by the laity. And in spite of all evidence to the contrary this is still the popular belief. It is true that any educated physician will now admit that albumin may be absent with kidney disease and present without it, but this admission is largely theoretical. In practice the old belief makes itself felt, and the presence of albumin is still looked for as the main evidence of disease of the kidneys.

The general belief concerning the albumin has been that it is removed from the blood by the kidneys just as urea or sugar is, and that if large quantities of it are removed from the blood the composition of this fluid is changed. A good deal of pains has been taken to discover why it is that diseased kidneys should excrete albumin.

As a matter of fact the presence of serum albumin and serum globulin in the urine means that the blood serum, of which they are constituents, has become mixed with the urine. The simplest way in which this can happen is to have bleeding from the bladder or kidneys so that the blood and urine are mixed. The ordinary way is for the blood serum to transude from the kidney capillaries just as it does from capillaries in other parts of the body. Albumin in the urine, therefore, means the same thing as serum in a serous cavity, that there has been a transudation of serum from the vessels. To keep the matter clear in our minds, whenever we use the word albuminuria we should do so with the idea that it is a popular way of saying that the urine has blood serum mixed with it. In this way we will think of the kidney as we do of other parts of the body—as liable to exudations of serum either of inflammatory or of dropsical character. But, just as in the serous membranes the exudation is not in the membrane but in its cavity, so in the kidney the exudation is not into the parenchyma but into the tubules.

THE CAUSES of albuminuria, therefore, are the same as the causes of dropsies in all parts of the body:

1. *Changes produced by inflammation in the walls of the capillaries* which render them more permeable. In this way are produced the albuminuria of both forms of acute nephritis, that of the severe

forms of acute degeneration, of acute congestion, and of some of the cases of chronic nephritis with exudation.

2. *Changes in the composition of the blood*, causing either increased filtration or increased secretion of serum. This would account for the albuminuria of anæmia, of puerperal eclampsia without nephritis, of the mild cases of acute degeneration, of some of the cases of acute and chronic nephritis with exudation.

3. *Changes in the blood pressure.* This would be the probable cause of the albuminuria in some of the puerperal cases, in chronic congestion, in some of the cases of chronic nephritis with exudation, and in chronic nephritis without exudation.

4. *Non-inflammatory changes in the walls of the capillaries*, rendering them more permeable to the escape of serum. Such changes would account for the albuminuria which is found without inflammation of the kidneys, changes in the blood, or alterations in the blood pressure.

THE SIGNIFICANCE of albumin in the urine depends, therefore, altogether upon its causation. As a symptom it may be compared to cough. It is well known that, while cough is a frequent symptom of disease of the lungs, yet its presence does not tell us what the disease of the lungs is, nor does it even tell us that there is necessarily disease of the lungs at all. Albuminuria, while it always means that the capillaries of the kidneys allow the blood serum to transude through their walls, does not tell us whether the causation of this transudation resides in the kidneys or outside of them. The study of this causation is practically a study of the causes of dropsy.

ALBUMINURIA WITHOUT DISEASE OF THE KIDNEY.

The examination of the urine by the physicians of life insurance companies, and by other physicians who have examined this excretion in the case of school children, of soldiers, and of other groups of persons, has brought out the fact that albumin is present in the urine in many persons who have no disease of the kidneys. These persons can be arranged in the following groups:

1. *Paroxysmal or Cyclic Albuminuria.*—The characteristic features of this form of albuminuria are: that the quantity of albumin is large, while casts are few or absent; that if we examine the urine at regular intervals during the twenty-four hours we find a regular rise and fall in the quantity of albumin. The albumin begins to appear soon after the person rises in the morning, increases through the day, falls after he goes to bed, disappears at night, and reappears the next day. This regular cycle can be disturbed by changing the hours of rest, of meals, and of exercise. The rule is that the appearance of the

albumin is favored by exercise and by eating, while rest in bed causes it to disappear. There seems to be no way of accounting for this form of albuminuria except by supposing that there are changes in the composition of the blood, or in the walls of the renal capillaries.

The persons in whom this form of albuminuria is present are regularly young males, who also suffer from more or less disturbance of the general health. The patients suffer from anæmia, lose flesh and strength, have headaches, neuralgic pains, bodily and mental languor, hysteria, and disturbances of the functions of the stomach, liver, and intestines. But there is a great difference in the patients as to how far these additional symptoms are developed. In some they are but trifling, in others they are well marked.

To distinguish these patients from those who have a true nephritis is by no means easy; the diagnosis may remain doubtful for months, and even then it is difficult not to make mistakes.

The treatment of these patients consists in the regulation of the diet and mode of life and the management of the disturbances of digestion and of the condition of the blood. The diet should be liberal and varied, but all indigestible articles of food must be excluded. Massage, hot and cold baths, and regulated exercise are to be systematically carried out. A climate which admits of many hours' daily exposure to the open air and sunlight is to be preferred.

All disorders of digestion are to be remedied as far as possible.

The change in the composition of the blood is not marked; neither the quantity of hæmoglobin nor the number of blood-cells is much diminished; iron is of service in the treatment of the affection, but does not act as a specific.

The prognosis as regards the life and health of these patients is good, but it may be very hard to get rid of the albumin altogether.

2. *Dietetic Albuminuria.*—This occurs both in children and in adults. It may follow the ingestion of only certain kinds of food—cheese, pastry, and eggs; or of any kind of food; or of any food which is not properly digested; or it may occur when exercise follows immediately upon the ingestion of food. The quantity of albumin is small and there are few or no casts.

If this form of albuminuria is temporary, it is not a serious condition, but if the disposition to it persists, the patients are to be regarded with suspicion. They are also liable to temporary glycosuria; they may have well-marked functional disturbance of the liver; they may have the gouty disposition; or they may have cirrhosis of the liver, or chronic endarteritis.

The treatment consists in regulating the diet and exercise in the same way as in persons with the gouty disposition; in relieving con-

stipation; and in the use of the drugs which are likely to increase the production of bile.

3. *Albuminuria after Exertion.*—The exertion must be severe and prolonged, in long and fatiguing marches by soldiers; prolonged contests in walking or running; violent exercises such as boxing or wrestling. The quantity of albumin may be considerable and numerous casts may also be present. It seems probable that this form of albuminuria is due to a congestion of the kidneys caused by the exertion. After the cessation of the exertion the albumin regularly disappears within a few hours or days. But a repetition of such temporary congestions of the kidney might lead to the development of a true nephritis.

4. *Simple Persistent Albuminuria.*—These patients may for years have small quantities of albumin nearly every day, but not at all hours in the day. The albumin is not abundant, it often disappears after rest; there may also be a few hyaline casts. The patients have no other symptoms of kidney disease, even when they are under observation for years. But one always feels anxious concerning such persons. Sooner or later they are apt to develop chronic nephritis, or endocarditis, or endarteritis.

Uræmia.

It is well established that the principal function of the kidneys is to remove from the body a quantity of excrementitious substances. It is equally well established that a number of the diseases of the kidney interfere with this function and allow the excrementitious substances to accumulate in the blood and tissues. It is a matter of daily observation that persons who suffer from kidney disease exhibit symptoms of such a character as to give the idea that these persons are in some way poisoned. The sequence seems to be logical: disease of the kidneys, failure to eliminate excrementitious substances, accumulation of such substances in the blood and tissues, poisoning of the body by these substances, the development of symptoms due to the poisoning. To such a morbid process the name of "uræmia" can properly be given. So in the year 1894 we find the following definition of uræmia in Dunglison's Medical Dictionary: "Certain morbid phenomena, implicating the nervous centres more especially, due to retention of excrementitious substances in the blood which are normally excreted by the kidneys, as in Bright's disease." And this definition fairly represents the popular belief concerning uræmia.

Unfortunately it is not possible to dismiss the subject in this easy way. We are confronted with many contradictions difficult of ex-

planation, and a review of the history of the subject shows that these difficulties have always been felt.

The simplest explanation of the phenomena of uræmia—that they are due to the presence of urea in the blood—has been contended for by many observers from the time of Christison down to the present moment. The proof has been derived from the examination of the blood in human beings, and from experiments on animals.

It has been demonstrated over and over again that the blood of persons suffering from uræmic attacks may contain a large excess of urea, that their serous effusions may contain large quantities of urea, and even that the urea may appear as a dry powder on the surface of the skin. It has also been shown that in a number of cases the outbreak of uræmic convulsions is preceded by a diminution in the excretion of urine and of urea.

The experiments on animals have consisted in injections of urea into the veins, in the introduction of urea into the stomach, and in abolishing the function of the kidneys by ligating the blood-vessels or the ureters.

The introduction of urea in considerable quantities into the veins or into the stomach is well borne by animals provided that the kidneys perform their functions. The urea is eliminated with the urine. If, on the other hand, after the injection of urea into the blood the animal is entirely deprived of fluids, or the functions of the kidney are arrested by operation, then vomiting, diarrhœa, muscular contractions, and death regularly follow.

Ligature of the blood-vessels of the kidneys, or of their ureters, or extirpation of the kidneys is followed by an accumulation of urea in the blood and tissues. The animals have vomiting and diarrhœa, become stupid, and die.

The contradictions to this theory of uræmia were soon noted. Owen Rees was one of the first to call attention to the fact that prolonged anuria is not necessarily accompanied with renal symptoms. His illustrative case was a patient in whom one kidney was absent; the ureter of the other kidney became blocked by a calculus, and there was complete suppression of urine. The quantity of urea in the blood was much increased. The patient died, but there were no uræmic symptoms. Cases of suppression of urine lasting for a number of days are not infrequent, and the ordinary experience has been that it is precisely in these cases that uræmic symptoms are absent, although death regularly follows.

More than this, Bartels and others have found that the blood drawn immediately after a uræmic attack may contain no excess of urea. It is a matter of ordinary experience that uræmic symptoms may come

on in persons who are passing a normal quantity of urine of good specific gravity. So there seems to be no escape from the facts that complete suppression of urine is not regularly followed by uræmic symptoms, and that uræmic symptoms may occur without an excess of urea in the blood, or a diminution in the excretion of normal urine.

So far as the experiments on animals are concerned they seem merely to show that urea in the blood does but little harm, and that abolition of the functions of the kidneys causes death.

It was to escape from some of these difficulties that Frerichs proposed the explanation that the cause of uræmic symptoms was poisoning by carbonate of ammonia. He taught that urea in excess in the blood did no special harm, but that if by the action of some ferment the urea was changed into carbonate of ammonia, then symptoms of intoxication would regularly follow. This theory, at one time popular, is now so entirely abandoned that it is not necessary to state the objections to it.

A modification of the theory of intoxication by urea is that of intoxication by urea and the other excrementitious substances of the urine together. The same affirmative and negative facts are to be found for this theory as for that of poisoning by urea alone. Normal uncontaminated urine injected into the veins of animals seems to do little harm unless the kidneys of these animals are injured by operation. If the kidneys are operated on, the animals die.

In human beings there are the patients with uræmic symptoms and an excess of excrementitious substances in their blood and tissues; the patients with uræmic symptoms, but without any excess of excrementitious substances; and the patients with anuria, an excess of excrementitious substances, and no uræmic symptoms.

A very important modification of the chemical aspect of the question is that made by Oppler and others. They hold that it is an error to think that urea or any other constituent of the urine acts as a blood poison. Rather an interference with the functions of the kidneys must lead to a disturbance of the regular chemical changes in all parts of the body. Such an interference is followed by a change in the nutrition of the tissues which shows itself in loss of weight, in anæmia, and in disturbances of the functions of the brain. This way of looking at the subject is certainly a very rational one.

The opposition to all the chemical explanations of uræmia looks to changes in the blood pressure as the exciting cause of uræmic attacks. The most complete theory of this kind is that of Traube.

This theory explains the occurrence of uræmic attacks as follows: The disease of the kidneys causes thinning of the blood serum, hypertrophy of the left ventricle of the heart, and an excess of blood pres-

sure in the arteries. If by any accidental circumstance the blood tension is suddenly increased, or the blood serum still further thinned, œdema and anæmia of the brain are produced. The form of the uræmic attack will vary with the portion of the brain which is rendered anæmic or œdematous. If the cerebral hemispheres alone are involved the patient simply becomes comatose; if the central portions of the brain alone are affected there will be convulsions without coma; if both the hemispheres and the central portions of the brain are anæmic and œdematous, both convulsions and coma are developed.

Traube also states:

That he never saw an attack of uræmia in renal disease where the left ventricle of the heart was not hypertrophied, and where an increase of tension in the aortic system could not be demonstrated;

That the diluted state of the blood serum can be recognized by the pallor of the skin and mucous membranes, and the presence of dropsical effusions;

That in every instance in which he examined the brain after death he could confirm the existence of anæmia and œdema;

That the presence of blood effusion within the cranial cavity in many of these cases confirms the suspicion that the abnormally high arterial blood pressure to which these effusions owe their origin has also something to do with the production of the œdema which is present at the same time.

Experiments on animals have also shown that by ligating the ureters, then the jugular vein on one side, and then injecting water into the carotid on the same side, general convulsions and coma can be produced. After death œdema of the brain without extravasation of blood is found.

The objections to Traube's theory are obvious: In patients who exhibit well-marked cerebral symptoms the specific gravity of the blood serum is not always lowered; the arterial tension is not always increased; neither anæmia nor œdema of the brain can always be demonstrated after death. These are facts which are soon ascertained by any one who sees much of kidney disease.

The marked uræmic symptoms which occur at the close of pregnancy, and are known under the name of puerperal eclampsia, differ from ordinary uræmic attacks in that they may occur without marked structural changes in the kidneys. A variety of explanations have been offered as to their causation.

The older British and American obstetricians taught that puerperal convulsions were caused by determination of blood to the head—cerebral congestion. Traube's theory of altered blood, increased arterial tension, with anæmia and œdema of the brain can be applied

to the puerperal cases of uræmia as well as to those associated with kidney disease.

A retention in the blood of some toxic agent, with consequent poisoning of the blood centres, has been a favorite theory with many. The toxic material has been thought to be: urea, carbonate of ammonia, urea with kreatin and other excrementitious substances, or ptomaines produced by the growth of bacteria.

The convulsions are attributed by some to cerebro-spinal disturbance from peripheral stimulation quite independently of the kidneys. Others believe that the convulsions are due to blood poisoning, but that the renal disturbance which causes the blood poisoning is due to vasomotor spasm of the small renal vessels with consequent degenerative changes in the kidneys, the vasomotor spasm resulting from some reflex irritation.

It is also believed that some puerperal convulsions are simply acute epileptic attacks, the area of distribution of the sciatic nerve being the epileptogenic zone.

More recently attention has been called to the probability that the so-called uræmic symptoms are due to a poison in the blood, but that this poison is not due to any disturbance of the function of the kidneys. This idea is only a theory, but it offers a promising field for study. It may very well be that we must look for the cause of these symptoms altogether outside of the kidneys.

It is evident from what has been said that there is no entirely satisfactory way of accounting for the so-called uræmic symptoms. At the present time the only very useful thing to do is to try and state as clearly as possible the conditions of the problem which we wish to solve.

THE SYMPTOMS which it is customary to call uræmic are:

1. *Headache and sleeplessness*, which come on in attacks of short duration, or may be continued for many weeks. The headache may be of mild type, or very severe. In extreme cases the pain is so severe and the sleeplessness so distressing that the patients are almost maniacal. These symptoms may accompany:

(*a*) Puerperal Eclampsia either with or without Nephritis. At the time of the attack the urine is diminished in quantity but of good specific gravity. The arteries are full and tense, the heart's action is exaggerated, the veins are congested. The headache can be relieved by the birth of the child, by general blood-letting, by morphine, and by the drugs which dilate the arteries.

(*b*) Acute Exudative and Acute Productive Nephritis. At the time of the attack the urine is often, but not always, diminished; its specific gravity is good. The arteries are full and tense, the heart's

action is exaggerated. The headache can be relieved by the arterial dilators, by morphine, by purging, by sweating. General blood-letting can but seldom be used.

(*c*) Chronic Nephritis with Exudation. The urine is often diminished but may be increased in quantity; its specific gravity is low. The condition of the arteries and heart is not constant. The arteries may be full and tense, or small and tense, or full and soft, or small and feeble. The heart's action may be exaggerated, or feeble; the valves may be diseased, or the left ventricle hypertrophied. The headache can sometimes be relieved, but late in the disease nothing will control it. The arterial dilators are of use only when the pulse is tense. The cardiac stimulants may do good when the heart's action is feeble. Thorough daily sweating is sometimes efficient. Purging can give temporary relief. Opium may be the only drug that is of any use. Mild cases can be relieved by improving the action of the digestive tract.

(*d*) Chronic Nephritis without Exudation. The headache and sleeplessness are especially frequent and severe with this form of nephritis. The urine is often diminished, but may be increased or normal in quantity; its specific gravity is low. The condition of the heart and arteries is liable to the same variations as in chronic nephritis with exudation, but a full, tense pulse and an hypertrophied left ventricle are more regularly present. The first attack of headache can usually be relieved, but each successive attack is more difficult to manage.

2. *Hemiplegia and Aphasia.*—These two symptoms, which may occur separately or together, are seen in patients who have chronic nephritis without exudation, and in women with puerperal eclampsia. The invasion of the hemiplegia is sudden and it is usually accompanied by coma. There is loss of motion alone or of both motion and sensation. The hemiplegia, coma, and aphasia may continue up to the time of the patient's death, or disappear after a few days. In the latter case the patient may have several such attacks. In chronic nephritis the hemiplegia may occur either early or late in the course of the disease. In these patients chronic endarteritis, especially of the cerebral arteries, is very regularly present. I think that it is probable that the hemiplegia is due to the endarteritis, rather than to the kidney disease.

The treatment of this condition is not satisfactory. If there is well-marked arterial tension it may be proper to try and reduce it, otherwise it is better not to interfere.

3. *Sudden Blindness.*—Besides the loss of vision due to nephritic retinitis, there may be a sudden blindness which lasts for hours or

days. In these patients no anatomical changes in the eyes have been discovered. This form of blindness is not uncommon in puerperal eclampsia; it occurs in a moderate number of the cases of chronic nephritis. We do not understand the nature or treatment of this blindness; fortunately it only lasts for a short time.

4. *General Epileptiform Convulsions.*—These have always attracted much attention as one of the most terrible and dangerous of the results of kidney disease. They may accompany:

(*a*) Puerperal Eclampsia, either with or without nephritis, coming on either before, during, or after labor. At the time of the attack the urine is sometimes diminished or suppressed, sometimes of normal quantity. The arteries are regularly full and tense, the heart's action is exaggerated, the skin is congested. It seems to be generally conceded that in these patients the convulsions are not all due to the same cause. There is also a substantial agreement as to the best methods of treatment. General blood-letting for the patients with excessive venous congestion, chloroform inhalations for the irritable patients, and the drugs which dilate the arteries are the routine treatment.

(*b*) Both Forms of Acute Nephritis. In children suffering from acute nephritis convulsions are of quite frequent occurrence, even when the disease is not of severe type. So many children recover after one or more convulsions that they are not grave symptoms. In adults convulsions do not occur nearly as often as in children, but the patients are much more likely to die. In children general blood-letting can very seldom be practised; in adults there are a few cases in which it is appropriate. In most of the patients the drugs which dilate the arteries give altogether the best results.

(*c*) Chronic Nephritis with Exudation. The convulsions belong to the advanced cases of the disease, to the patients who are dropsical, anæmic, and apparently thoroughly poisoned with excrementitious substances. The heart's action and the pulse are feeble. In these patients it is difficult, or impossible, to control the convulsions. The most efficient plan seems to be the daily sweating with the hot pack.

There are cases of chronic nephritis with exudation in which an exacerbation of the inflammation takes place, and the patients then behave much as if they had an acute nephritis.

(*d*) Chronic Nephritis without Exudation. Convulsions are of frequent occurrence early in the disease as well as late; indeed, in many persons the attack of convulsions is the first symptom of the nephritis. Many of the patients have hypertrophy of the left ventricle of the heart and chronic endarteritis in addition to the nephritis. Common as these attacks are, their causation is most ob-

scure, for there can be no question that the liability to the convulsions is not at all in proportion to the failure of the functions of the kidneys. Certainly a marked increase in arterial tension is the rule with these attacks, and the control of the convulsions is in proportion to the success in dilating the arteries. But there are cases in which we are not able either to dilate the arteries or to control the convulsions; and there are cases in which the convulsions continue although the pulse becomes rapid and feeble. It is for the convulsions with this form of nephritis that hypodermics of morphine are of so much efficacy for a time. It must be admitted that when a patient with chronic nephritis begins to have convulsions death is not far off.

5. *Contractions of Groups of Muscles.*—These are of common occurrence in the severe forms of acute and chronic nephritis and in puerperal eclampsia. Very often they merely precede an attack of general convulsions. They are best marked and of longest continuance in the advanced cases of chronic nephritis with exudation.

6. *Delirium and Coma.*—They come on suddenly in attacks, either associated with convulsions or by themselves; or they are developed slowly and gradually and continue for a considerable length of time. The attacks belong to the severe cases of acute nephritis, to the exacerbations of chronic nephritis with exudation, and to the ordinary cases of chronic nephritis without exudation. The gradual development of delirium and coma is apt to continue, although sometimes with intervals of improvement, up to the time of the patient's death. They are very often seen in the advanced stages of both forms of chronic nephritis.

7. *Vomiting* is seen in many cases of nephritis. It is evidently due to a number of different causes. In acute nephritis the vomiting seems to be of the same character as that which may occur with an acute inflammation of any part of the body. In chronic nephritis the vomiting may be due to chronic gastritis; or the stomach, like the intestine, gets rid of some of the accumulated urea and serum.

Besides these forms of vomiting there is a special and aggravated form which belongs regularly to the cases of chronic nephritis without exudation. It is usually accompanied by a marked increase of arterial tension. The vomiting is frequent, distressing, and may continue for days. The most efficient means of controlling it are chloral hydrate by the rectum in twenty-grain doses, or hypodermic injections of morphine.

8. *A Rise of Temperature.*—In acute nephritis, as in any other acute inflammation, there may be a febrile movement. As a rule the temperature is not high and falls to the normal within a week. But in children temperatures of 104° or 105° F. may be reached.

In chronic nephritis the severe attacks of cerebral symptoms—headache, convulsions, delirium, coma, hemiplegia—are not infrequently accompanied with a considerable rise of temperature. I have seen it as high as 109° F., and yet the autopsies show no reason for the febrile movement.

9. *Dyspnœa* is one of the most frequent and interesting of the symptoms of nephritis. There is a dyspnœa due to fluid in the pleural cavities, or to œdema of the lungs; a dyspnœa due to pressure on the diaphragm by fluid in the abdomen; and a dyspnœa due to bronchitis or to contraction of the bronchi; but the most important form of dyspnœa is one which is independent of all these causes and is directly caused by disturbances of the circulation. It belongs to both forms of chronic nephritis, but is more common with nephritis without exudation. The patients, as a rule, in addition to the nephritis have pulmonary emphysema, chronic endarteritis, hypertrophy of the left ventricle, or chronic endocarditis. Not infrequently one or more of these lesions are much more advanced and apparently more important than the kidney disease. Especially is this the case with chronic endarteritis, which gives many of the most marked examples of this form of dyspnœa with but very little nephritis.

The dyspnœa may come on at any time in the course of a nephritis; very often it is the first symptom which causes the patient to seek medical advice. It begins with attacks, which at first are brought on by bodily and mental exertion, or come on of themselves at an early hour in the morning. In none of the attacks do we hear the characteristic breathing of bronchial asthma. The attacks at first only last for an hour or so, and during the rest of the day the breathing is comfortable. But even in these mild attacks the patients cannot lie down. As time goes on the attacks become more frequent and of longer duration. Finally comes the terrible period when the breathing is always bad, the patients cannot lie down at all, and yet go on living for weeks and months.

The treatment of this dyspnœa is often for a time extremely satisfactory. The patients are enabled to live and work in comfort for many years. But each succeeding attack is harder to control than the first, and finally there comes a time when everything fails and the dyspnœa continues although the patient is stupefied with drugs.

The object of treatment is to relieve the disturbances of the circulation; if this can be done the dyspnœa is also relieved. To effect this the most exact study of the circulation is required. For each patient the character of the heart's action and of the pulse, both relatively and separately, must be determined. Based on this knowledge is the intelligent use of cardiac stimulants and sedatives, of

arterial dilators, of regulation of the functions of the stomach, liver, and intestines, of rest or exercise. There is no one plan of treatment for all, nor even one plan for the same patient in all attacks.

Increased Arterial Tension.—This is not always classed with the uræmic symptoms. It is, however, one of the most frequent and important of the symptoms of chronic nephritis, and it is by it that many of the so-called uræmic symptoms are produced.

It has been believed that this increased tension of the blood in the arteries is due to chronic changes in the walls of the arteries and capillaries which interfere with the passage of the blood through them. The explanation is very probably true up to a certain point, but it does not account for the attacks of increased arterial tension which come and go within a few hours. I do not see how these can be produced except by the temporary contraction of arteries which have a well-developed muscular coat, such as the radial artery. I think that it is possible to demonstrate after death in such arteries an hypertrophy of the muscular coat, in patients who have had many attacks of increased arterial tension.

If this is admitted, then we have to find a reason for the attacks of contraction of the arteries which last for hours or for weeks, and which can often be controlled by the drugs which dilate the arteries.

Such attacks of contraction of the arteries occur with:

Angina pectoris;

Chronic endocarditis;

Chronic arteritis;

Pulmonary emphysema;

Chronic nephritis.

It seems as if such a contraction of the arteries must be due to some irritating substance in the blood. But whether there is only one poison which acts in this way or several poisons, and how such poison or poisons are produced, we do not know.

Acute Congestion of the Kidneys.

Definition.

A temporary congestion of the blood-vessels of the kidney, which may be accompanied with exudation of serum and escape of red blood-cells.

Etiology.

Acute congestion is caused by the ingestion of certain poisons, by extirpation of one of the kidneys, by severe injuries inflicted on any

part of the body, by surgical operations, especially those on the bladder and urethra, and by over-exertion.

Morbid Anatomy.

It is but seldom that we are able to obtain human kidneys in the state of acute congestion, for the condition is not usually a fatal one. In animals, however, the condition can be produced experimentally by cantharidin. It is found that the kidneys are enlarged, that the veins, capillaries, and Malpighian tufts contain an increased quantity of blood, and that the epithelial cells of the cortex tubes are flattened.

Symptoms.

Acute congestion may occur in kidneys previously normal, or in those already diseased.

The urine is diminished in quantity or suppressed; its specific gravity is unchanged; it contains blood, albumin, and casts.

(1) Congestion Caused by the Ingestion of Poisons.

Cantharides given internally, or used in blisters or ointment, is rather a frequent cause of acute congestion of both the kidneys and the bladder.

The urine is diminished in quantity; it is passed frequently, in small quantities, with much pain; or it is retained. It contains albumin, a few casts, and blood. Sometimes large, jelly-like coagula are formed in the bladder.

The patients may have a moderate rise of temperature, pain in the back, abdominal pain, nausea and vomiting, diarrhœa, more or less prostration, delirium, and stupor. The severity of the symptoms depends on the quantity of the drug absorbed. In the bad cases of poisoning the condition of the kidneys is not that of hyperæmia, but of actual inflammation.

When there is only hyperæmia the patients are sick for a few days, and the urine soon returns to its natural condition. Turpentine produces symptoms like those of cantharides.

Treatment.—If the poison has been taken into the stomach, that organ is to be emptied and washed out. Warm baths, or a hot pack, and the use of small doses of opium are of service. Camphor in doses of from 2 to 5 grains every three hours has been recommended in cantharides poisoning.

(2) Congestion Following the Removal of One Kidney.

The urine is scanty or suppressed, and contains albumin and casts. The patients are in a condition of prostration which is very alarming. They may remain in this condition for a few days and then recover, the urine returning after a time to its natural condition; or they become more and more feeble, pass into the typhoid condition with mild delirium, and die.

Treatment.—The patients are to be kept perfectly quiet in bed, on a fluid diet. They should have one or two long hot packs every day so as to produce congestion of the skin and profuse perspiration.

(3) Congestion after Injuries, or Surgical Operations.

It is well known that any operation on the bladder or urethra, even the passage of a catheter, may be followed by suppression of urine, great prostration, and death within forty-eight hours, and that after death no lesion is found except congestion of the kidneys. These cases are not to be confounded with the cases of septic infection and fever, which may also follow operations on the urethra and bladder.

It is not so well known that surgical operations on any part of the body are occasionally followed by suppression of urine, congestion of the kidneys, and death. We do not know that death in all these cases is caused by the congestion of the kidneys, but there can be no question that congestion of the kidneys is produced in this way.

Treatment.—No satisfactory treatment has yet been found for these patients; in fact, the very short time which intervenes between the operation and death hardly gives time for treatment.

(4) Acute Congestion after Over-Exertion.

Prolonged marches, violent gymnastic exercises, contests of walking and running prolonged over several days may be followed by the excretion of such a quantity of albumin and casts in the urine as to indicate a temporary congestion. I do not know of any post-mortem observations which corroborate this belief. There are no other symptoms besides the changes in the urine, and these disappear after a few days' rest.

Chronic Congestion of the Kidneys.

There are a number of morbid conditions which interfere with the circulation of the blood in the aortic system in such a way that the

blood accumulates in the veins and is diminished in the arteries. The most common of these conditions are: chronic inflammation of the aortic and mitral valves, dilatation of the heart, aneurism of the arch of the aorta, pulmonary emphysema, and large accumulations of fluid in the pleural cavities.

In pulmonary emphysema the disturbances of circulation are confined to the cases in which there is obstruction to the passage of blood through the lungs, dilatation and hypertrophy of the right ventricle, and then venous congestion of the aortic system. More or less dropsy is regularly developed at about the same time as the congestion of the kidneys.

Large accumulations of fluid in the pleural cavities, if they remain for any length of time, may produce well-marked chronic congestion. This is denied by Bartels, who says that he has never known congestion or any serious disturbance of the renal functions to occur as a result of pleuritic exudations. I have, however, seen congestion produced in this way a number of times. I think that it is a lesion of consequence to the patient, and I believe that it furnishes an additional reason for the early removal of fluid from the pleural cavities.

Etiology.

By far the most common cause of chronic congestion of the kidneys is disease of the heart. So long as a heart with chronic endocarditis, or myocarditis, or dilatation is able, in spite of its damaged state, to carry on the circulation fairly well, no secondary changes in the kidneys are produced. But as soon as the blood accumulates in the veins to any considerable extent the kidneys suffer. One of three things regularly happens to them: either chronic congestion, or chronic degeneration, or chronic nephritis is developed. It is also necessary to remember that chronic endocarditis and chronic nephritis often exist in the same person, although neither one of them is secondary to the other.

Morbid Anatomy.

The kidneys are of medium size, or rather large. Their weight is increased somewhat out of proportion to the increase in size. The color is dark-red, the consistence is very hard, the surfaces are smooth, the capsules are not adherent. The congestion is most marked in the veins of the pyramids; they contain an increased quantity of blood, and are often dilated. The capillaries of the cortex are also congested, but it is rather exceptional to find them dilated. The

epithelium of the convoluted tubes is swollen, and the separate cells of which it is composed are more evident. Or, instead of this, the epithelium is much flattened so that the lumen of the tube is larger. I think that this flattening of the epithelium belongs to the kidneys which give urine containing a good deal of albumin.

The most constant and characteristic change is in the glomeruli. The capillaries which make up the glomerulus are dilated, with more or less thickening of their walls. So far as I know this change in

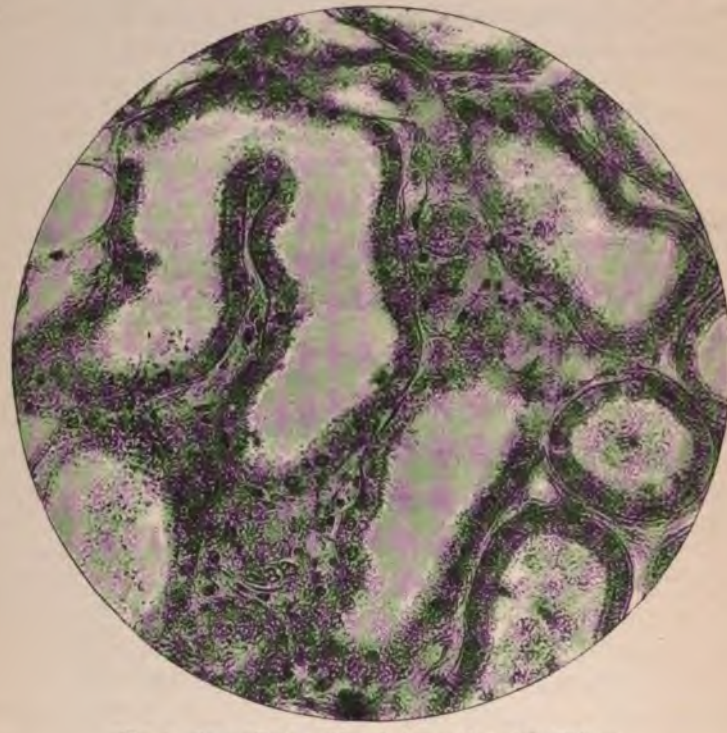

FIG. 1.—Cortex Tubes. Chronic Congestion of the Kidney.

the glomeruli is constant and persists, even if the congestion is succeeded by a true nephritis.

While the congestion often persists up to the time of the patient's death, it may, instead of this, be followed by an acute or a chronic nephritis.

If there is an acute nephritis albumin is present in considerable quantities in the urine. After death the glomeruli, in addition to the dilatation of their capillaries, show an increase in the size and number of the cells which cover them. The epithelium of the convoluted tubes is flattened.

If there is a chronic nephritis the specific gravity of the urine falls and the excretion of urea is diminished. The nephritis follows the anatomical type of a chronic nephritis without exudation, but the dilatation of the capillaries of the glomeruli persists.

Symptoms.

Of the persons who die with chronic congestion of the kidneys a large number present marked symptoms during life, but it is difficult to determine how largely these symptoms are due to the congestion of the kidneys.

A congestion of a few weeks' duration, such as we see with large effusions of fluid in the pleural cavities, seems to give no renal symptoms and no changes in the urine.

The question is complicated by the fact that with chronic endocarditis and pulmonary emphysema any one of the following kidney lesions may coexist: 1. Chronic congestion; 2. Chronic congestion followed by chronic exudative nephritis; 3. Chronic congestion followed by chronic nephritis without exudation; 4. Chronic degeneration; 5. Chronic degeneration followed by chronic nephritis with exudation; 6. Chronic nephritis with exudation not preceded by congestion; 7. Chronic nephritis without exudation not preceded by congestion.

Here are seven different kidney lesions, each one of them frequently associated with cardiac disease.

In bad cases of heart disease the ordinary symptoms are: dyspnœa, cough and expectoration, general dropsy, vomiting, headache, delirium, convulsions, coma, anæmia, loss of flesh and strength.

It is always difficult and often impossible in any given case of heart disease to determine certainly which kidney lesion exists. The general rules which we follow are these:

Chronic Congestion.—The cardiac symptoms not as severe; dropsy often present; the quantity of the urine moderately diminished, its specific gravity normal or higher than normal, albumin in very small quantities, few or no hyaline casts.

Chronic Congestion followed by Chronic Nephritis with Exudation.—The cardiac symptoms more severe; the dropsy well marked; the urine scanty, its specific gravity normal or lowered, a large quantity of albumin, and casts in variable number.

Chronic Congestion followed by Chronic Nephritis without Exudation.—The patients are liable to have attacks of contraction of the arteries. The dropsy is not as constant. The quantity of the urine varies, sometimes above, sometimes below the normal. Its specific

gravity is low. There is but little albumin except when the arteries are contracted. Loss of flesh and strength are marked features.

Chronic Degeneration.—The cardiac symptoms are severe; dropsy is regularly present but not always marked. The quantity of the urine varies, its specific gravity is unchanged, there is but little albumin. The patients are feeble and anæmic with a prolonged period of scanty urine, delirium, stupor, and the typhoid state.

Chronic Degeneration followed by Chronic Nephritis with Exudation.—The cardiac symptoms are severe and the dropsy well marked. The quantity of urine is small, its specific gravity is rather high than low. Albumin is present in large quantities, casts are not so constant. The patients are feeble, anæmic, and get worse rapidly.

Chronic Nephritis either with or without Exudation, not preceded by Congestion.—In these patients there is the ordinary history of chronic nephritis lasting for months or years. Then, as the endocarditis advances, the heart's action becomes worse, the circulation is disturbed, and the different cardiac symptoms are added.

Treatment.

Although we are unable to remove the mechanical interference with the circulation, yet the condition of the patients can often be very much improved. The main indications are to improve the character of the circulation and to remove the dropsy. In order to improve the circulation it is absolutely necessary to study the character of the heart's action, to appreciate the organic changes in the heart, and to determine whether the walls of the arteries are thickened and whether there is an increase or diminution of the arterial tension. It is unfortunate that there is no instrument to tell us certainly what the arterial tension is; we have to depend upon the sense of touch. This, however, can be educated, and a physician is not competent to manage cardiac cases if he cannot appreciate changes in arterial tension.

In many patients with an irregular heart, dyspnœa, and dropsy, simple rest is of the greatest service. This is especially marked in hospital patients who have tried to work up to the time of their admission. It is often a good rule to give no medicine to such patients until we see how much they improve with rest alone.

The regulation of the food is of importance. It is to be remembered that, while gastric indigestion and flatulence make the heart's action worse, on the other hand meat is one of the best cardiac stimulants. Most patients are better for meat in some form at least once a day.

Tumultuous and exaggerated heart action may be due to contraction of the arteries and require such drugs as nitroglycerin or chloral hydrate. It may be the expression of a heart which is really feeble and requires digitalis. It may mean a real exaggeration of the muscular action of the heart and be benefited by aconite, belladonna, and the local action of cold. A feeble heart without contraction of the arteries calls for cardiac stimulants; digitalis, strophanthus, and caffeine are the best. But it is to be remembered that with aortic and mitral stenosis, myocarditis, and diseased coronary arteries, there comes a time when cardiac stimulants make the heart's action worse instead of better. This is the time for the use of opium. Small doses of codeine or of morphine give the patient more relief than can be obtained in any other way.

In many patients the condition of the heart and arteries varies from day to day so that there have to be many corresponding changes and combinations of the drugs—the cardiac stimulants, the arterial dilators, and the opium.

The dropsy is more or less favorably affected by the rest in bed and the regulation of the circulation. It can also be reduced by the hot pack and the hot-air bath.

For very extensive cardiac dropsies, with only chronic congestion of the kidney or but little nephritis, calomel is the most efficient diuretic. Three grains of calomel with $\frac{1}{16}$ of a grain of morphine, four times a day for four days, is the dose. The mouth and gums are to be kept very clean. If the drug acts properly there is but little effect on the bowels and no salivation, but on the third day the quantity of urine increases and remains large for several days. The dropsy diminishes and may disappear altogether.

Acute Degeneration of the Kidneys.

Definition.

An acute change in the kidneys, characterized by degeneration or death of the epithelial cells of the tubules, to which may be added an exudation from the blood-vessels.

Synonyms.—Acute Bright's disease; Parenchymatous nephritis; Parenchymatous degeneration.

Etiology.

The introduction of certain poisons into the body is regularly followed by changes in the cells of the viscera. The poisons which

exert this effect are ordinarily mineral poisons, such as arsenic, mercury, and phosphorus; or the poisons of infectious diseases, such as diphtheria, typhoid fever, etc. According to the quantity and virulence of the poison received into the body, there are more or less marked changes produced in the cells of the viscera.

Small doses of such poisons, acting only for a moderate length of time, produce simple swelling of the cells. The cells are swollen, more opaque, more coarsely granular. They are not dead, nor broken down, nor do they contain any new substances; the change in their appearance is due to the swelling of the network which forms a part of every cell. Under these circumstances there are either no changes at all in the blood-vessels of the viscera, or a slight congestion, with, perhaps, a little exudation of serum.

Larger doses of such poisons, or more virulent poisons, or a longer duration of the action of a poison, are attended by the deposition in the cell-bodies of granules of albuminous matter and globules of fat. At the same time there is a change in the nutrition of the cells, and they are often broken and disintegrated. Under these conditions there may be considerable congestion of the vessels and an exudation of serum.

Very large doses of such poisons cause the death of the cells of the viscera, a death which may take the form of coagulation-necrosis or of disintegration and breaking down of the cell. With these changes there will often be an excessive congestion of the vessels and a large exudation of serum.

As the kidneys are excreting organs it is rather natural to think that the substances which cause degeneration of the renal epithelium do so because they are excreted by the kidneys. But, as the same poisons produce similar degeneration in many other parts of the body, it seems more probable that the effect of the poison is produced in the same way that it is in the nerves, the muscles, the liver, and the spleen.

The well-known fact that temporary cutting off of the arterial blood from the kidneys in animals is followed by degeneration or death of the renal epithelium, has led to the idea that degeneration of the kidneys, especially in cholera, is due to ischæmia. This seems possible, but it is a theory not at all applicable to most cases of acute degeneration.

It is curious that so many different poisons should act in the same way. There seems to be nothing in common between the poison of corrosive sublimate and that of yellow fever, and yet the changes in the kidneys are practically the same.

The inorganic poisons, arsenic, etc., act according to the size of

the dose taken. A small dose produces only moderate degeneration of the renal epithelium, a large dose causes extensive necrosis with considerable exudation of blood serum.

The toxines of the different infectious diseases vary as to the activity of their effect on the renal epithelium, as to the time in the disease when the degeneration takes place, and as to the frequency with which true nephritis is produced instead of acute degeneration. It is a question of much importance whether the same toxine produces

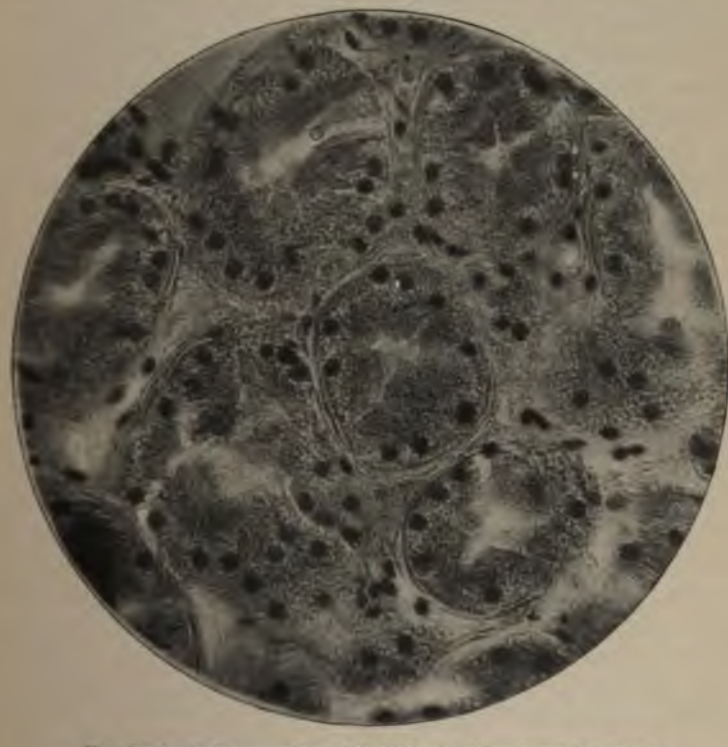

Fig. 2.—Acute Degeneration of the Kidney. Phosphorus Poisoning.

degeneration or nephritis according to its dose, or whether two or more different toxines are necessary. In scarlatina and diphtheria, for example, the rule is that acute degeneration comes in the early days of the disease, acute exudative nephritis in the late days of the disease, and acute productive nephritis just after the close of the disease. Does this mean three different toxines, or that the same toxine varies at different stages of the disease, or that the only difference is in the dose?

For clinical purposes the recognition of the fact that acute degen-

eration is the ordinary lesion of the infectious diseases is of much practical importance.

Morbid Anatomy.

The gross appearance of the kidney varies with the extent of the degeneration. In the ordinary mild cases, such as accompany pneumonia, the kidney is a little larger, the cortical portion a little thicker and paler. In the severe cases, such as accompany acute yellow atrophy of the liver, the kidney is considerably enlarged and more or less congested.

The changes in the renal epithelial cells are: a simple swelling of the cell body, causing it to look larger and more opaque and to take on irregular shapes; an infiltration of the cell bodies with granules of albuminoid matter and fat; a death of the cells, which may take the form of coagulation necrosis or of a disintegration of the cell bodies; a desquamation of the dead cells so that the tubes are filled with them; a formation of hyaline masses in the cells; a growth of new cells to take the place of the dead epithelium. All these changes are most marked in the convoluted tubes.

In the kidneys with extensive necrosis of the epithelium there may also be congestion of the blood-vessels and casts in the tubes.

Symptoms.

With the severe acute degeneration which follows the ingestion of large doses of arsenic, mercury, or one of the other inorganic poisons the urine is diminished in quantity, or suppressed; it contains albumin, casts, and blood; its specific gravity is unchanged. At first the general symptoms belonging to the poison predominate, but as these subside the patients continue to live and suffer more or less severely from the degeneration of the kidney. They become feeble, pass into the typhoid state, and often die.

The acute degeneration which accompanies the infectious diseases such as scarlatina, diphtheria, typhoid fever, pneumonia, etc., is for the most part of mild type and gives no symptoms except the presence of a little albumin and a few casts in the urine. It is of importance to recognize the frequency with which this affection of the kidney occurs, the slight injury which it inflicts on the patient, and the completeness with which the kidney lesion disappears after the recovery from the primary disease. Much unnecessary anxiety is often felt by physicians because in a case of pneumonia or some other infectious disease they find albumin and casts in the urine. There are fears not only of death from the primary disease, but of the sub-

sequent development of "Bright's disease." If the albumin and casts are due to degeneration of the kidneys anxiety is needless. The course of the primary disease will not be changed. If the patients recover their kidneys return to their normal condition.

With yellow fever, with acute yellow atrophy of the liver, and occasionally with the other infectious diseases the degeneration is of intense type, with death of a large part of the renal epithelium and exudation from the vessels. In such cases the urine is scanty or suppressed. It contains albumin, casts, and blood. The patients are very ill, they may have convulsions, delirium, or stupor; they often die. But it is hard to tell how many of their symptoms are due to the complicating kidney lesion.

Treatment.

So far as the degeneration of the epithelium is concerned, we know of no treatment which is likely to affect it favorably. But in the severe cases with congestion of the kidneys and scanty urine it seems to be good practice to use the hot-air bath or the hot pack.

It is evident that acute degeneration of the kidney can be sharply distinguished from all other forms of kidney disease. It is always produced by the introduction of some poison into the body. It is not accompanied by dropsy, contraction of the arteries, or by other renal symptoms. It is not usually dangerous to life. It is a temporary condition not followed by any chronic kidney disease. If the patient recovers from his poisoning the kidneys return to their normal condition.

Chronic Degeneration of the Kidneys.

Definition.

A chronic disease of the kidneys characterized by degenerative changes in the renal epithelium.

Synonyms.—Chronic Bright's disease, Chronic parenchymatous nephritis, Fatty kidney.

Etiology.

The same mechanical obstructions to the circulation—heart disease, pleuritic effusions, etc.—which produce chronic congestion, can, instead of this, produce chronic degeneration of the kidney.

It is said that anæmia of the kidneys produces degeneration of the renal epithelium. Experiments upon animals show that this view is theoretically possible. It may be that the degeneration of the

kidneys seen in old and feeble persons is due to a diminished blood supply, but we can hardly speak with certainty on this point.

Chronic diseases, such as phthisis and cancer, are followed by chronic degeneration of the kidneys.

There is a group of cases in which, although the health of the patients is not good, it is not easy to fix on a definite cause for the chronic degeneration.

Apparently many of the authors who describe a "chronic parenchymatous nephritis" include under this head both chronic degeneration and chronic nephritis.

The matter is further complicated by the fact that kidneys may be in the condition of chronic degeneration for some time and then become further altered by a chronic nephritis with exudation, and by waxy degeneration of the glomeruli.

Morbid Anatomy.

If the degeneration follows heart disease the kidneys are large, weighing together from sixteen to twenty ounces. Their surfaces are smooth; the cortical portion is thickened, of pink or white color, the pyramids are red. The gross appearance is that of the so-called large white kidney. The epithelium of the cortex tubes is swollen and coarsely granular. The capillaries of the glomeruli are dilated, with more or less thickening of their walls. The veins in the pyramid are congested. There are no changes in the stroma, or in the arteries.

If the degeneration follows phthisis, cancer, or any wasting disease, the kidneys are usually large, with a white or yellowish cortex. There are no changes except in the cortex tubes. In these the epithelial cells are either coarsely granular, or infiltrated with fat.

If the degeneration occurs in old people, or without discoverable cause, the kidneys may be either large and white, or of the size and appearance of a normal kidney, or small and red. There are the same degenerative changes in the epithelium of the cortex tubes, with no lesions in the stroma or the glomeruli.

Symptoms.

With the degeneration caused by heart disease the quantity of the urine varies with the changes in the action of the heart and the contraction of the arteries, sometimes abundant, sometimes scanty, sometimes suppressed. The specific gravity is not diminished, nor

is the proportion of urea to the ounce diminished. Albumin and casts in small quantities are more frequently present than with chronic congestion. While it is difficult to separate the kidney symptoms from the heart symptoms, yet one has the impression that this kidney lesion is more serious than chronic congestion and has its effect in increasing the loss of nutrition and the anæmia.

If the degeneration is followed by chronic nephritis with exudation albumin appears in the urine in large quantities; the anæmia and dropsy are very marked, and the patients get worse rapidly.

When the degeneration accompanies chronic diseases, such as phthisis or cancer, the urine remains normal, or from time to time contains a little albumin and a few casts. The patients are so ill with their primary disease that the secondary degeneration of the kidneys is hardly appreciable during life.

The group of cases in which the degeneration occurs without discoverable cause is interesting, for the kidney lesion may be the cause of death. It is a difficult group to study, because the cases are not very numerous, and the clinical histories and autopsies are apt to be dissociated. The autopsies are for the most part in hospital patients with short and imperfect histories; while the clinical histories are of private patients on whom it is difficult to obtain autopsies. I think, however, it can be said that the urine remains normal, or from time to time contains a little albumin and few casts, and that neither dropsy, nor a pulse of high tension, nor an hypertrophied left ventricle, nor acute uræmic symptoms are present.

The patients gradually, month after month, lose flesh and strength and become more or less anæmic. They may have a variety of digestive disturbances. The course of the disease is slow, sometimes interrupted by periods of improvement, but regularly getting worse from year to year. Finally the patients are so feeble that they remain in bed; they develop alternating delirium and stupor, and so die.

The diagnosis in these cases is extremely difficult. They resemble cases of malignant disease in which no tumor can be found, and cases of chronic nephritis with normal urine and no changes in the heart or arteries.

Treatment.

It is not easy to find means to influence chronic degeneration of the renal epithelium. The best that we can do for the patients is to stop all vicious habits, to regulate the diet and mode of life, and to relieve the disturbances of circulation.

Acute Exudative Nephritis.

Definition.

An acute inflammation of the kidneys, characterized by congestion, exudations of the blood plasma, emigration of white blood-cells, diapedesis of red blood-cells, to which may be added changes in the renal epithelium and in the glomeruli.

Synonyms.—Acute Bright's disease; Parenchymatous nephritis; Tubal nephritis; Desquamative nephritis; Catarrhal nephritis; Croupous nephritis; Glomerulo-nephritis.

Etiology.

Acute exudative nephritis is frequently a primary inflammation, occurring either after exposure to cold or without discoverable cause. It may complicate any one of the infectious inflammations or diseases, but is especially common with scarlet fever. It is one of the forms of nephritis which are caused by pregnancy.

Acute exudative inflammation in any part of the body seems to be caused by local irritation, by the presence of irritating substances in the blood, and by changes in the circulation of the blood in the inflamed portion of the body. Pathogenic bacteria are sometimes present, sometimes absent in the inflamed tissue.

Unquestionably all the infectious diseases are often complicated with inflammations of different parts of the body. The probable causes of these are the chemical poisons produced by the growth of the pathogenic bacteria belonging to each disease. It seems also that the poison of each disease has a preference for particular portions of the body. In rheumatism the joints and heart are regularly inflamed; in measles, the bronchi; in scarlet fever and diphtheria the throat and the kidneys.

As regards the presence of bacteria in the kidneys themselves as exciting causes of inflammation our knowledge is uncertain.

Whether nephritis in puerperal women and after exposure to cold is due to disturbances of circulation or to some poison in the blood is not certain.

There are marked differences in the severity of different cases of nephritis. The exudation of serum is larger in one case, the emigration of white blood-cells in another. In one kidney the epithelial cells are contracted, in another they are swollen and degenerated. The glomeruli are much more changed in some kidneys than in others. How closely these differences in the lesions correspond to differences in the causation of the nephritis we do not know.

Morbid Anatomy.

In a nephritis of this type we should expect that the inflammatory products, the serum, white and red blood-cells, and coagulable matter from the blood-plasma, would collect in the Malpighian bodies and tubes, or infiltrate the stroma between the tubes; and that of the inflammatory products in the tubes and Malpighian bodies, a part would be discharged with the urine and a part be found in the kidney after death. We should also expect that the quantity of inflammatory products would be in proportion to the severity of the inflamma-

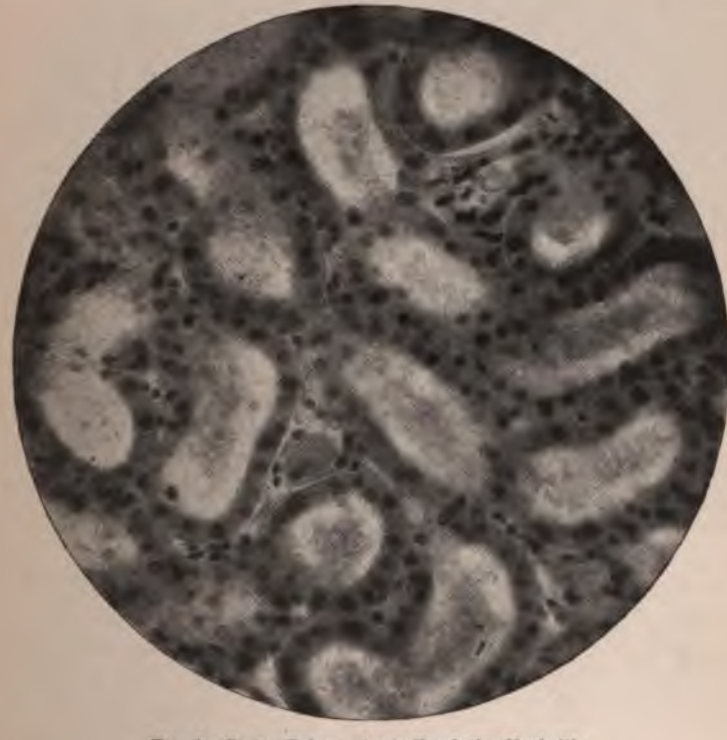

Fig. 3.—Cortex Tubes. Acute Exudative Nephritis.

tion, and that an excessive number of pus-cells would belong to the especially severe forms of the disease. Still further, it is evident that with the milder examples of nephritis, with but little exudation, no inflammatory products might be found in the kidney after death, all having been discharged into the urine during life.

As a matter of fact, the kidneys do present just such changes. In the mild cases we find no decided lesions in the kidney after death.

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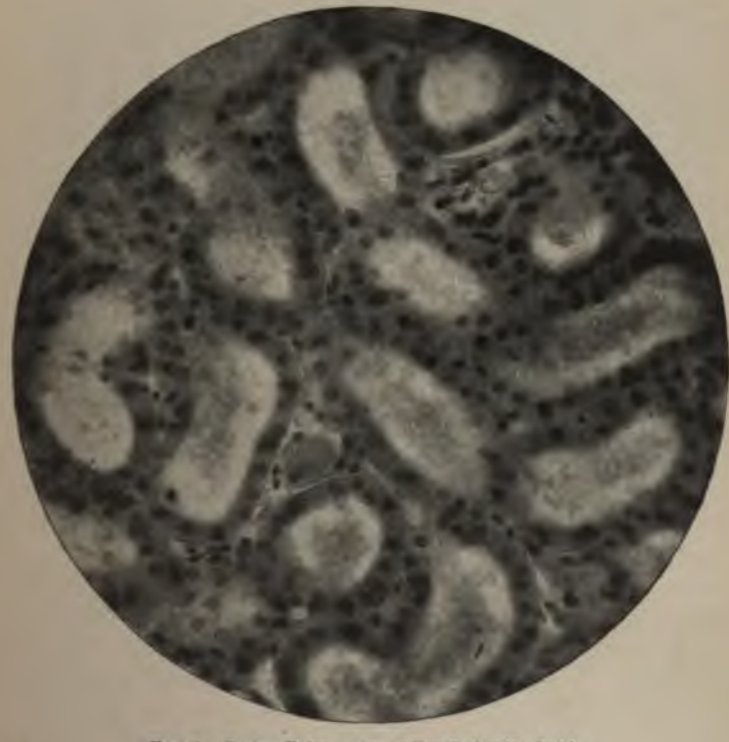

Fig. 8.—Cortex Tubes. Acute Exudative Nephritis.

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As a matter of fact, the kidneys do present just such changes. In the mild cases we find no decided lesions in the kidney after death.

In the more severe cases the kidneys are increased in size, their surfaces are smooth, the cortical portion is thick and white, or white mottled with red, or the entire kidney is intensely congested. If the stroma is infiltrated with serum, the kidney is succulent and wet; if the number of pus-cells is very great, there will be little whitish foci in the cortex.

In such kidneys we find the evidence of exudative inflammation in

Fig. 4.—Cortex Tubes. Acute Exudative Nephritis.

the tubes, the stroma, and the glomeruli, all the changes being most marked in the cortical portion of the kidney.

The epithelium of the convoluted tubes is often simply flattened. As this same appearance is also found in the chronic congestion of heart disease, it seems probable that this change of the shape of the cells is merely due to the inflammatory congestion.

In other cases, not only is the epithelium flattened but there is also a real dilatation of the cortex-tubes. This dilatation involves groups of tubes, or all the cortex-tubes uniformly.

In other cases, the epithelium of the convoluted tubes is swollen, opaque, degenerated, and detached from the tubes.

The tubes, whether with flattened epithelium or dilated, may be empty. More frequently, however, they contain coagulated matter in the form of irregular masses and of hyaline cylinders. The irregular masses are found principally in the convoluted tubes; they seem to be formed by a coagulation of substances contained in the exuded blood-plasma, and are not to be confounded with the hyaline globules so often found in normal convoluted tubes. The cylinders are more numerous in the straight tubes, but are also found in the convoluted tubes. They also are evidently formed of matter coagulated from the exuded blood-plasma, and are identical with the casts found in the urine.

The tubes may also contain red and white blood-cells.

In the cases in which there is an excessive emigration of white blood-cells, we find these cells in the tubes, in the stroma, or distending the capillary veins. This excessive emigration is not necessarily attended with exudation of the blood-serum, and so the urine of these patients may contain no albumin. The white blood-cells are not usually found equally diffused through the kidneys, but are collected in foci in the cortex. These foci may be very minute, or may attain a considerable size.

The glomeruli regularly are changed. The cavities of the capsules may contain coagulated matter and white and red blood-cells, just as do the tubes. The capsular epithelium may be swollen, sometimes so much so as to resemble the tubular epithelium, and this change is most marked in the capsular epithelium near the entrance of the tubes.

The most noticeable change, however, is in the capillary tufts of the glomeruli. These capillaries are normally covered on their outer surface by flat, nucleated cells, so that the tuft is not made up of naked capillaries, but each separate capillary throughout its entire length is covered over with these cells. There are also flat cells which line the inner surfaces of the capillaries, although not uniformly, as is the case in capillaries in other parts of the body. Still, in spite of the presence of all these cells, the outlines of the walls of the capillaries are fairly distinct.

In exudative nephritis the swelling and growth of cells on and in the capillaries change the appearance of the glomeruli. They are larger, more opaque, the outlines of the main divisions of the tuft are visible, but those of the individual capillaries are lost.

It is difficult to tell how much these changes in the glomeruli interfere with the passage of the blood through their capillaries.

In most cases of exudative nephritis the patients recover, and the glomeruli return to their natural condition.

In some examples of exudative nephritis we also find a thickening of the walls of the branches of the renal artery within the kidney. This thickening is principally due to a swelling of the muscle-cells in the walls of these vessels.

All these changes in the kidneys are of such a character that they are not likely to be followed by a chronic nephritis. On the contrary, after the patients have recovered, the kidneys return to their normal condition.

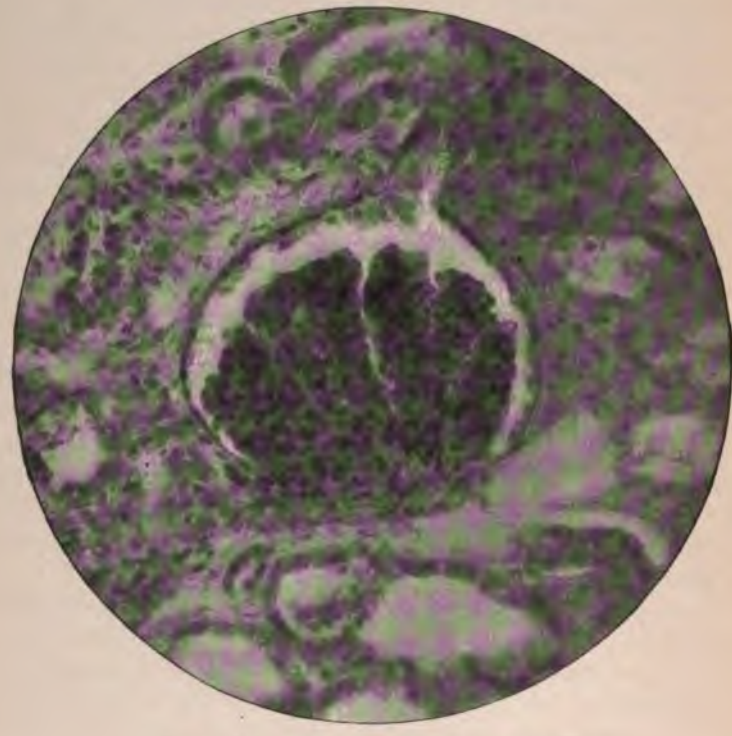

FIG. 5.—A Glomerulus. Acute Exudative Nephritis.

SYMPTOMS.

1. There are cases of acute nephritis of so mild a character that they may easily be overlooked. I think that these mild cases occur more frequently than is commonly supposed. The patients are hardly sick enough to go to bed. They have a little headache, perhaps some aching in the back and limbs, loss of appetite, a little nausea, and the feeling of general malaise. They often think that they

have taken cold. These indefinite symptoms last for one or two weeks, disappear, and the patient is well again. If the urine is not examined it is not known that the patient has been suffering from a mild nephritis. If the urine is examined it is found that the quantity is somewhat diminished, the specific gravity is not lowered, an appreciable quantity of albumin is present, with hyaline, granular, and epithelial casts, sometimes with red and white blood-cells. If the number of blood-cells is sufficient to color the urine, the patient's attention is attracted by the change in color; the diminished quantity he is apt not to notice. These changes in the urine last for four or five weeks and then disappear.

2. The ordinary cases of acute exudative nephritis vary indeed in their severity, but all give characteristic symptoms. The only diseases with which they can be confounded are acute productive nephritis, and exacerbations of a chronic nephritis. If any person seems to have several attacks of acute nephritis, it regularly means that he has a chronic nephritis with exacerbations.

The quantity of urine is diminished at the onset of the nephritis and continues small until the activity of the inflammation has subsided; then the quantity increases from day to day and may even exceed the normal. The quantity of the urine must be in proportion to the quantity of blood which passes through the kidneys, so that this quantity gives us a measure of the intensity of the congestion which is arresting the circulation of the blood through the kidney. Complete suppression of urine is a serious symptom, both because it denotes an intense nephritis and because it is of itself a cause of death. The production of only a few ounces of urine in each twenty-four hours is the rule in a great number of cases, and is not necessarily of serious import. If it lasts only a few days the patients do perfectly well. If the scanty excretion of urine is kept up for a number of days, opinions vary as to the results. Some believe that the diminished quantity of urine is the cause of the dropsy. Some think that the deficient excretion of excrementitious substances causes the convulsions. Some believe that the principal effect of a diminished excretion of urine is to cause bodily feebleness.

Unquestionably the production of urine may be very small for a number of days and yet the patients do well. Dr. Whitelaw (*Lancet*, Sept. 29, 1877) reports a case of anuria lasting for twenty-five days. The patient was a boy eight years old. The suppression of urine began twelve weeks after the beginning of a scarlet fever. With the exception of two ounces passed on the thirteenth day, there was complete anuria for twenty-five days. Except for slight headaches and later slight œdema, there were no uræmic or dropsical symptoms

throughout. There was no albuminuria and no fever. The boy was watched night and day. He recovered entirely.

The specific gravity of the urine remains normal or is higher while the quantity is small; when the quantity is increased the specific gravity falls a little.

The appearance of the urine is turbid, or smoke-colored, or bloody.

Albumin is present in very large quantities. Casts are numerous—hyaline, granular, nucleated, epithelial, and blood. There are also red and white blood-cells, and epithelial cells from the kidneys and from the bladder. As a rule the quantity of albumin and the number of casts are in proportion to the severity of the nephritis, but this is not always the case. Large quantities of albumin, numerous casts, and many red and white blood-cells may be found in the urine of kidneys which, after death, show no structural changes except in the glomeruli; while, on the other hand, small quantities of albumin and a few hyaline casts are compatible with a severe nephritis. Still further, the number of casts found in the urine during life is not always in proportion to the number of casts found in the corresponding kidneys after death.

The characteristic symptoms of acute exudative nephritis are: a febrile movement, with more or less prostration; headache, stupor, sleeplessness, restlessness, muscular twitching, general convulsions; dyspnœa, loss of appetite, nausea and vomiting; a pulse of high tension with exaggerated heart action, or hypertrophy of the left ventricle; dropsy and anæmia.

When acute nephritis complicates scarlet fever or one of the other infectious diseases, the patient may already have a febrile movement belonging to the primary disease. If the nephritis is primary, or if it is not developed until the fever belonging to the original disease has subsided, there is a rise of temperature belonging to the nephritis. This fever is in proportion to the severity of the nephritis, and in children is sometimes as high as 105° F. The fever, however, does not usually continue more than a week, although the nephritis lasts longer.

Headache, restlessness, sleeplessness, delirium, and stupor during the first days of an acute nephritis seem to be of the same nature as they are in so many severe inflammations attended with fever. But later in the disease, after the temperature has fallen, they apparently depend upon the increased tension in the arteries. In the cases of prolonged anuria, however, there is a condition of mild delirium and stupor with a soft pulse.

General convulsions are of not uncommon occurrence, especially in

children. They do not usually occur until after the nephritis has existed for several days. They are often preceded by involuntary contractions of groups of muscles. They may be preceded and followed by stupor. The frequency of their occurrence does not seem to be in direct relation to the quantity of urine excreted. They may be absent in fatal anuria, and present when the quantity of urine is nearly normal. It is the rule before and during the convulsions to have a marked increase in the tension of the pulse. While general convulsions are an alarming symptom, yet a great many children make a very good recovery after having them.

Loss of appetite, nausea, and vomiting at the beginning of the nephritis seem to be due to the febrile movement. Later in the disease it is probable that they are due to the disturbance of the function of the kidneys.

A pulse of high tension, exaggerated contractions of the heart, and sometimes hypertrophy of the left ventricle are present in some of the cases, not by any means in all of them. This disturbance of the circulation is evidently caused by contraction of the arteries. That the contraction of the arteries is due to the presence of irritating substances in the blood is probable, but not certain.

Dropsy is present in many of the cases. It is usually confined to the subcutaneous connective tissue. Its probable causes have already been discussed.

Anæmia, with a pallor of the skin out of proportion to the diminution in the quantity of hæmoglobin, is very often seen. We are still ignorant as to the way in which an acute nephritis causes such changes in the composition of the blood.

3. Acute exudative nephritis with an excessive production of pus cells. This is not to be confounded with embolic nephritis, nor with nephritis caused by cystitis. It is only a severe variety of acute exudative nephritis. It is seen both in children and in adults. I have seen it with scarlatina, diphtheria, and measles, and occurring without discoverable cause.

The invasion is sudden, with a high temperature and marked prostration. Restlessness, headache, delirium, and stupor are soon developed and continue throughout the disease. The patients rapidly lose flesh and strength and pass into the typhoid state. Dropsy is slight, or absent altogether. The urine is not so much diminished in quantity as one would expect. Its specific gravity is not changed. Albumin, casts, and red and white blood-cells are present in considerable quantities, but not always early in the disease, and they may even be absent altogether.

Although this form of nephritis is not of common occurrence, the

unusual character of the symptoms and the great mortality are reasons for calling special attention to it. It differs from the ordinary form of exudative nephritis in that it behaves like an infectious inflammation, and that, although the emigration of white blood-cells is large, the exudation of serum may be small, and so the urine may show but little change. It is probable that the nephritis is the result of some obscure form of bacteritic infection.

The ordinary duration of an acute exudative nephritis, which terminates favorably, is about four weeks, but may extend to eight. The recovery is a complete one, and there is no danger that chronic nephritis will follow.

Prognosis.

The patients, who for three or four weeks have only the fever, prostration, loss of appetite, nausea, anæmia, dropsy, and changes in the urine, as a rule recover completely and are not at any time in real danger.

The development of the cerebral symptoms—the stupor, headache, sleeplessnes, restlessness, and general convulsions—always causes anxiety, but yet even of these patients the larger number get entirely well. The cases with an excessive production of pus-cells differ from all the other forms of acute exudative nephritis, and are very fatal.

Treatment.

We have to treat an acute exudative inflammation of the kidneys, which naturally runs its course in four weeks and terminates in recovery. We have also to treat the symptoms of this nephritis—the scanty urine, dropsy, vomiting, anæmia, and cerebral symptoms. We have to treat these conditions more frequently in children than in adults, and very often as complicating an infectious disease.

The most efficient treatment of the nephritis is the application of heat to the entire surface of the body. This can be done in a number of ways, but the best way is to wrap the entire body in a blanket wrung out of hot water. Such a hot pack can be used for an hour at a time once or twice a day. Of drugs the most reliable is aconite—one or two minims of the tincture every hour. It may be necessary to precede the aconite by giving one drachm of sulphate of magnesia every hour until the bowels move, or until eight doses have been taken. There are cases, in which the nephritis is not of very acute type, where digitalis seems to exert a favorable effect on the circulation. The preferable form of the drug is digitalin in doses of one one-hundredth of a grain.

The scanty urine often causes anxiety. Of course it is better that the patients should pass a fair quantity of urine, but I think that there is a tendency to exaggerate the dangers of scanty urine and to be too energetic in giving diuretics. As the diminution in the quantity of urine is due to the congestion of the kidneys, if we can decrease the congestion the urine will increase. The best way to do this is to apply heat to the surface of the body. The use of diuretics is to be avoided. The attempts to make up for the scanty production of urine by purging or sweating the patient have never seemed to me to be of any practical use.

The febrile movement in an acute nephritis requires no treatment.

The prostration, loss of appetite, nausea, and vomiting only call for rest in bed and a fluid diet.

The anæmia ought to be prevented or relieved, but, while the nephritis is still active, I know of no way in which this can be done. When convalescence is established then the anæmia readily improves with the ordinary methods of treatment.

The dropsy is subcutaneous, and even when considerable, does little harm. It disappears of itself as the nephritis subsides. The rest in bed and the hot pack are all the treatment necessary for it. To give diuretics or cathartics to get rid of the dropsy is quite useless.

The cerebral symptoms are the ones to which most attention has been directed. There can be no question that they accompany a contraction of the arteries with increased arterial tension and labored action of the heart. No matter what views one may entertain as to the cause of this change in the circulation, I believe that treatment is best directed to the arteries themselves, rather than to the uncertain causes of their contraction. Fortunately there are drugs which stop contraction of the arteries promptly and efficiently. Of these drugs the most suitable are: aconite, nitroglycerin, chloral hydrate, and opium, preferably given in small doses and at regular intervals before the cerebral symptoms are marked, but in large doses hypodermically or by the rectum to stop a severe attack.

It is wise to watch the condition of the heart and arteries, and, as soon as increased arterial tension is developed, not to wait for the manifestation of the cerebral symptoms, but to try to relieve it at once.

The way in which we manage the patients, therefore, is as follows: They are put to bed or kept in the house until the nephritis has run its course. They are put on a fluid diet, preferably milk, and the skin of the entire body is cleaned once a day. For many cases no other treatment is necessary.

If vomiting is troublesome it can usually be controlled by adding

oxalate of cerium and bicarbonate of soda to the milk. For the restlessness and sleeplessness chloral hydrate, the bromides, or opium may be employed.

If the nephritis is of severe type the patient is wrapped in a blanket wrung out of hot water and kept in it for one hour either once or twice every day. In addition we give one drachm of sulphate of magnesia every hour until the patient has taken eight doses or the bowels begin to move. This is followed by one or two minims of tincture of aconite every hour.

Throughout the disease we watch the pulse, and as soon as it shows any increased tension give chloral hydrate in doses of from two to five grains every three hours.

If severe headache, muscular twitchings, or general convulsions occur, to most of the patients we give chloral hydrate in doses of from 5 to 20 grains by the rectum, or nitroglycerin in doses of from $\frac{1}{200}$ to $\frac{1}{50}$ of a grain hypodermically, or morphine in doses of from $\frac{1}{10}$ to $\frac{1}{6}$ of a grain hypodermically. In strong and robust adults with a good deal of venous congestion general blood-letting may be advisable. For the relief of the convulsions urethane in solution, given in repeated doses up to 100 grains in twenty-four hours, is said to be of service.

As the nephritis subsides the milk is gradually replaced by solid food, and iron and oxygen are given.

Acute Productive (or Diffuse) Nephritis.

Definition.

An acute inflammation of the kidneys, characterized by exudation from the blood-vessels, a growth of new connective tissue in the stroma, and changes in the epithelium and the glomeruli.

Synonyms.—Acute Bright's disease; Parenchymatous nephritis; Croupous nephritis; Glomerulo-nephritis.

Etiology.

This is the most serious and important of the forms of acute nephritis for the reason that its lesions are from the first of a permanent character. It does not follow exudative nephritis, nor is it merely a modification of it; from the very outset it is a different form of inflammation. In the kidneys of persons who have been sick only a few days, the characteristic lesions are already evident. Productive nephritis is governed by the same law as that which belongs to productive inflammation in other parts of the body—the disposition of

the inflammation to continue as a subacute and chronic condition. It is of importance to recognize that in exudative nephritis the lesions are temporary, and after their subsidence the kidneys return to their normal condition, just as the lungs do after a lobar pneumonia. In productive nephritis, on the other hand, some of the lesions are permanent, the kidneys can never return to their normal condition, just as in an interstitial pneumonia the lung never gets rid of the new connective tissue.

Post-scarlatinal nephritis is nearly always of the productive form. Nephritis complicating diphtheria or developed during pregnancy is

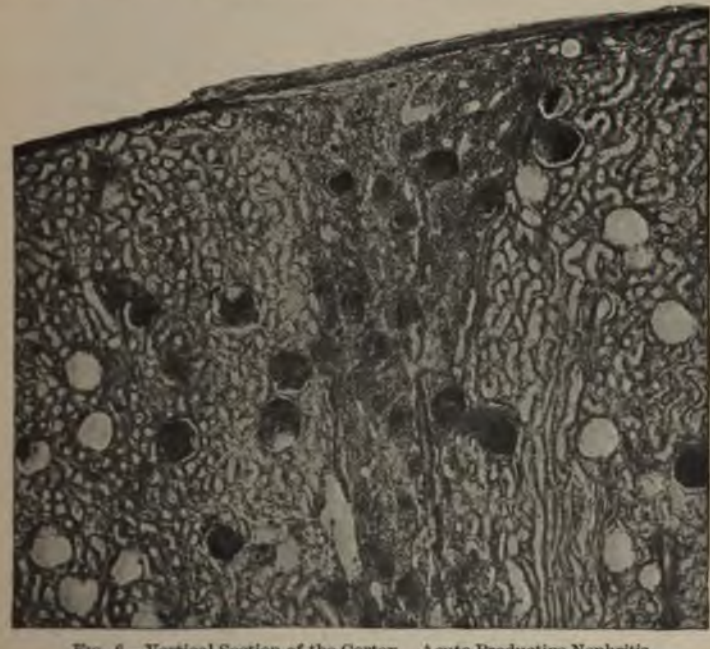

FIG. 6.—Vertical Section of the Cortex. Acute Productive Nephritis.

very frequently of this type. A primary nephritis in a person over twelve years old, if of subacute form, is almost invariably a productive nephritis. On the other hand, this form of nephritis very seldom complicates any of the infectious diseases except scarlatina and diphtheria.

These facts assist very much in making the diagnosis between the two forms of acute nephritis. It is easy to remember that post-scarlatinal nephritis and primary nephritis of subacute type are nearly always of the productive form; and that nephritis with diphtheria and pregnancy is often of the productive form; while acute nephritis under all other conditions is regularly of the exudative form.

Morbid Anatomy.

The kidneys are increased in size, the capsules are not adherent, the surfaces are smooth. The cortical portion is red, or white, or mottled. The mucous membrane of the pelvis is sometimes congested. Of the tubules in the cortex, in some the epithelium is flattened, in some there is coagulated matter or casts, in some the epithelium is swollen, degenerated, or contains globules of fat. In those parts of the cortex where there is a growth of new connective tissue, the tubes may be atrophied. The tubules of the pyramids show but little change except that they may contain casts. In the stroma of the cortex there is a growth of new connective tissue, varying in different kidneys as to the relative proportion of cells and basement

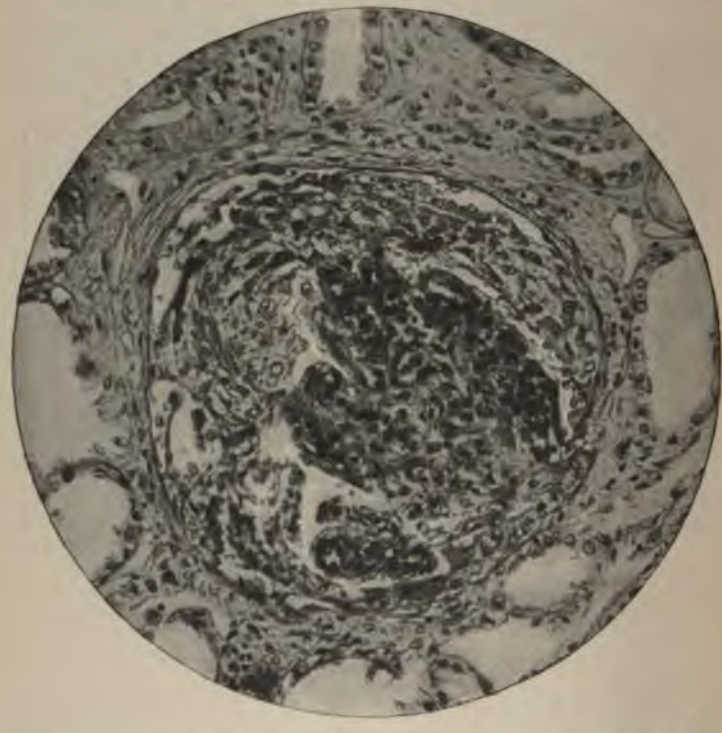

Fig. 7.—A Glomerulus with Growth of Capsule Cells. Subacute Productive Nephritis.

substance. This new tissue in many of the kidneys follows the line of the arteries which run up into the cortex, so that it takes the form of wedges. But in other kidneys the new tissue is diffuse, or in irregular patches.

Many of the glomeruli show only an increase in the size and num-

ber of the cells which cover the capillaries, with some swelling of the capsule cells. But in others there is an extensive new-growth of capsule cells which compresses the tuft of vessels. This growth of new cells from the capsule cells must not be confounded with accumula-

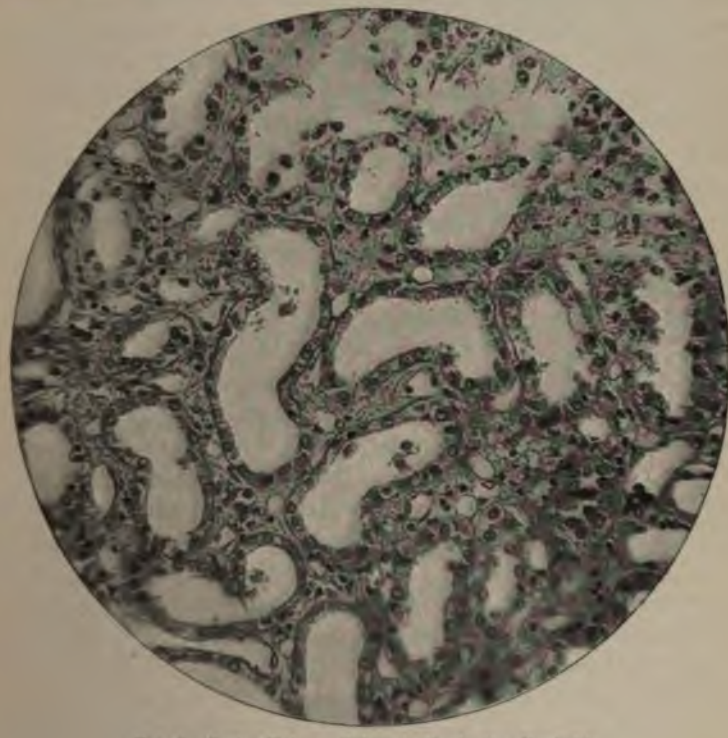

FIG. 8.—Cortex Tubes. Subacute Productive Nephritis.

tions of white blood-cells within the capsules, nor with the growth of new cells on the walls of the capillaries. The glomeruli which are changed in this way are in groups, each group corresponding to some one artery.

The whole picture of the nephritis is that of a combination of exudative and productive inflammation.

When such a nephritis becomes chronic it is often possible to follow its course for many years, and to see at the end of that time that the anatomical changes in the kidney are of the same kind, but much more extensive.

SYMPTOMS.

Of the patients who suffer from this form of nephritis, a certain number behave as if they had a simple exudative nephritis.

There is a rise of temperature, with more or less prostration. Cerebral symptoms are marked—headache, stupor, sleeplessness, restlessness, muscular twitchings, and general convulsions. The arteries are contracted, the pulse is of high tension, the heart's action is exaggerated, the left ventricle may be hypertrophied, there is dyspnœa. The appetite is lost, there may be nausea and vomiting. The urine is scanty or suppressed, it is colored by blood and contains much albumin and many casts. The patients are very sick and much more likely to die than they are with an exudative nephritis.

Such a nephritis may, however, apparently run its course. At the end of four weeks the symptoms subside and the patients get better. They may then remain in ordinary health without renal symptoms for weeks, months, or years. But sooner or later they have another acute attack, or they gradually develop the symptoms of a chronic nephritis.

The more ordinary cases have a gradual invasion, and run a subacute rather than an acute course.

In some of the patients at first there are only loss of appetite, headaches, and an increasing pallor of the skin and mucous membranes; the dropsy does not come on until after many days.

In some of the patients dropsy of the legs is the first and, for a time, the only symptoms. They continue to eat well, feel well, and attend to their work.

In most of the patients dropsy of the legs and face, anæmia, headache, sleeplessness, loss of appetite, nausea and vomiting are developed at about the same time.

The urine is only moderately diminished in quantity; it often contains no blood, there is a large quantity of albumin and a considerable number of casts. The specific gravity remains normal, or falls a little.

The cases vary a good deal as to their severity.

Some of the patients are not at any time very sick. A moderate subcutaneous œdema, anæmia, headache, and disturbances of digestion last for a few weeks, then disappear, and the patients seem to be well. Some of them do get well, but the majority either have other attacks of the same character, or develop the symptoms of chronic nephritis. It is surprising for how many years some of these patients go on in apparent good health, although the kidneys are really becoming more and more diseased.

In some patients the dropsy is much more extensive and involves the serous cavities as well as the subcutaneous tissue. For a number of weeks these patients are in bed and very badly off. And yet even the bad attacks may subside altogether, the patients are appar-

ently well, are able to go back to their work, and have no more trouble for years.

In some patients there is first a well-marked attack of dropsy, anæmia, headache, sleeplessness, loss of appetite, nausea and vomiting, which lasts for a few weeks. Then the symptoms subside and the patients are pretty well, but not very well. After this they have attacks of the same kind at intervals of weeks or months, and this may go on for years. In hospital patients the attacks regularly come on every winter and the patients are comparatively well in the summer. Each attack, however, is worse than the preceding, and finally there comes an attack which proves fatal. In these long cases the specific gravity of the urine becomes lower from year to year.

The severe and progressive cases are most distressing to witness. The patients are constantly getting worse, and yet months may elapse before their sufferings are terminated by death. The color of the skin and of the mucous membranes becomes more and more white; headaches are constant and troublesome; sleep is difficult and unrefreshing; the eyesight is impaired or lost altogether; there is no appetite but rather constant nausea and irritability of the stomach; from time to time the arteries are contracted and there is a disposition to muscular twitchings and general convulsions. The dropsy constantly increases no matter how large the excretion of urine. The subcutaneous connective tissue is everywhere œdematous and the serous cavities are filled with serum. It seems as if the blood serum was unable to remain in the vessels, it escapes everywhere.

Prognosis.

The majority of cases of acute productive nephritis terminate unfavorably. Either the disease goes on continuously and the patients die at the end of a few days or a few months; or the acute symptoms subside and a chronic nephritis supervenes. It is not wise, however, to give too unfavorable a prognosis even in severe cases; great improvement and even complete recovery are possible. I see from time to time persons in apparently good health and able to earn their living, concerning whom I have given a very unfavorable prognosis many years ago.

Treatment.

In those cases in which the disease behaves like an acute exudative nephritis the indications for treatment are the same as in the latter disease, although the results are not so satisfactory.

The subacute cases have to be managed differently. At first it is

wise to keep the patients in bed and on an exclusively milk diet. In some of the patients the daily use of the hot pack seems to be of service, in some nothing is gained by its use, in some it is I think harmful. I do not know how to distinguish the appropriate cases for the hot pack except by trying its use for a few days.

Digitalis, preferably in the form of digitalin in doses of $\frac{1}{100}$ of a grain, seems in some of the cases to exert a favorable effect on the nephritis—at all events the quantity of albumin in the urine diminishes and the patients improve; but in some other cases it does nothing. In the same way morphine in small doses, sometimes not more than $\frac{1}{60}$ of a grain, relieves the headache, sleeplessness, and nausea, and the patients are evidently better for it. But there are other patients to whom the morphine is of no service whatever.

The dropsy is always of consequence. It is associated with a soft pulse; a fair heart action, rather feeble than forcible; no great disposition to venous congestion. The composition of the blood is profoundly changed by the diminution in the quantity of hæmoglobin and the number of red blood-cells, and probably in other ways which we do not appreciate. The quantity of urine may be either diminished or increased. The dropsy, therefore, does not seem to depend on changes in the blood pressure or in the quantity of urine, but rather on changes in the composition of the blood or in the walls of the arteries. It is a dropsy which it is very difficult to treat intelligently.

There are cases in which the dropsy will disappear simply with the rest in bed and the milk diet.

There are cases in which profuse sweating by the hot-air bath or the hot pack diminishes the dropsy. But some of these patients cannot be made to sweat, some of them are too much depressed by the heat, in some the sweating does not diminish the dropsy.

Hydragogue cathartics, such as jalap and elaterium, will often diminish the dropsy for a time. Their use, however, cannot be continued for any length of time without irritating the stomach and intestines.

The daily use of good massage with compression of the legs by bandages is sometimes of real value.

Digitalis, caffeine, and strophanthus in many cases act efficiently, even when they do not increase the quantity of urine. They are the most useful drugs for this particular purpose.

The use of diuretics is limited to the cases in which the quantity of urine is diminished. In a patient with increasing dropsy, who is already passing 90 or 100 ounces of urine a day, diuretics are not indicated. The drugs ordinarily employed to effect diuresis are those

which act on the circulation—digitalis, caffeine, strophanthus, and convallaria; and those which are supposed to act on the kidneys—acetate of potash, lactate of strontium, squills, diuretin. Good results are reported from the use of those drugs. But experience shows that in some patients the quantity of urine cannot be increased, and in others the increase in the quantity of urine is not followed by diminution of the dropsy.

It would seem as if the disposition to dropsy could be controlled if we could control the composition of the blood, increase the number of the blood-cells, and raise the specific gravity of the blood serum. Unfortunately we do not know how to do this.

When necessary, to make the patient more comfortable, we have to tap the peritoneal and pleural cavities and to puncture the skin of the legs.

If the patients improve, the milk diet is to be gradually replaced by solid food, iron is to be given in fair doses, and the patient gets out of bed and out of the house. At this time climate becomes a matter of much importance. The patient should be sent to a warm, dry, equable climate where he can lead an out-of-door life.

Chronic Productive (or Diffuse) Nephritis with Exudation.

Definition.

A chronic inflammation of the kidney attended with a growth of new connective tissue in the stroma, permanent changes in the glomeruli, degeneration of the renal epithelium, exudation from the blood-vessels, and sometimes changes in the walls of the arteries.

Synonyms.—Chronic Bright's disease; Chronic parenchymatous nephritis; Chronic glomerulo-nephritis; Waxy kidney; Large white kidney; Chronic diffuse nephritis; Chronic desquamative nephritis.

It has been customary to hold that in all these kidneys the primary and most important changes are in the renal epithelium, while in another set of kidneys the primary and important changes are in the stroma. In other words, that the cases of chronic nephritis can be divided into two classes—parenchymatous nephritis and interstitial nephritis.

I do not think that this classification is supported by facts.

In all the forms of chronic nephritis changes are to be found in the renal epithelium, the glomeruli, and the stroma. Whether the changes in the stroma, the glomeruli, or the epithelium are the more marked makes no difference in the clinical symptoms. But the presence or absence of exudation from the renal blood-vessels does corre-

spond to a marked difference in the symptoms. The existence of the exudation from the renal vessels is easily shown by the presence of serum albumin in the urine. In this way we readily distinguish two forms of chronic nephritis, one with exudation and one without.

The way of looking at the matter, then, is this:

We find after death from chronic nephritis a great many varieties in the gross appearance of the kidneys. Some are large, some are small, some are red, some are white, etc. There is no regular correspondence between these different gross appearances of the kidneys and the clinical symptoms.

We find in these same kidneys change in the renal epithelium, in the stroma, in the glomeruli, and in the arteries. Sometimes one, sometimes the other of these elements of the kidneys is the most changed. There is no regular correspondence between the predominance of the changes in one of the kidney elements over the other and the clinical symptoms.

The easiest working scheme is to admit that in chronic nephritis all the elements of the kidney are more or less changed, but that the cases vary as to whether there is or is not an exudation of serum from the blood-vessels. The presence or absence of such an exudation does correspond to a well-marked difference in the clinical symptoms.

In the present state of our knowledge and for clinical purposes we divide all the cases of nephritis into two classes, chronic nephritis with exudation and chronic nephritis without exudation.

It is admitted that it is easy to divide up these kidneys according to their anatomical changes into a number of fairly well-marked classes. But as this division does not correspond to clinical divisions it is valueless for clinical purposes.

Although it is convenient to describe two forms of chronic nephritis—one with much albuminuria and dropsy, and one with little or no albuminuria, or dropsy—yet it must be remembered that these are not separate lesions of the kidneys, but varieties of the same lesion. For in all these kidneys two changes are constant—productive inflammation of the glomeruli and stroma, and degeneration of the renal epithelium. The only real difference between the kidneys is whether, besides the growth of new tissue and degeneration of renal epithelium, there is or is not an exudation of serum from the blood-vessels of the kidneys.

In speaking of the exudation of serum from the vessels and its presence in the urine, we speak of it as it occurs during the whole course of the disease, and not as it occurs for short periods. We mean that in an exudative chronic nephritis there is usually a large quantity of albumin in the urine, but that there may be periods dur-

ing which the albumin diminishes or entirely disappears. In the same way in a non-exudative nephritis there may be periods during which albumin is present in considerable quantities. Generally speaking, the character of the clinical symptoms will vary with the presence or absence of the albumin.

Etiology.

A considerable number of cases of chronic nephritis follow an attack of acute or subacute productive nephritis. The conditions of

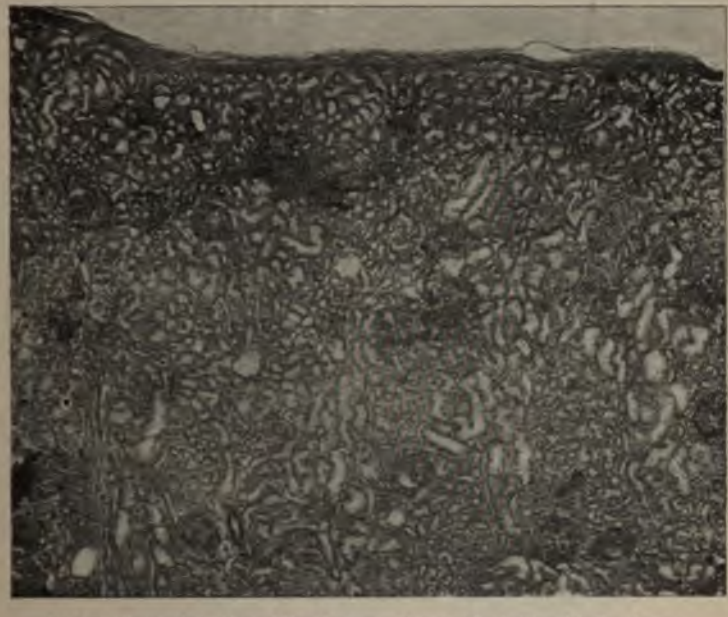

Fig. 9.—Vertical Section of the Cortex. Chronic Nephritis with Exudation.

chronic congestion and chronic degeneration of the kidney are not infrequently followed by a true nephritis.

Syphilis, chronic tubercular inflammation of any part of the body, chronic endocarditis, and chronic suppurative inflammations are often complicated with chronic nephritis.

It is very difficult to find a satisfactory cause for the primary cases. There are many of these, especially in young and middle aged adults. The nephritis is developed in a slow, insidious way in persons whose previous health has been good and in whom no exciting cause is discoverable.

Morbid Anatomy.

Gross Appearance of the Kidney.—There is considerable variety in the gross appearance of the kidneys. The types which I have seen most frequently are as follows:

1. Large white kidneys, weighing together sixteen ounces or more, the capsule adherent or not, the surface smooth or nodular, the cortex thick and white, the pyramids large and red.

2. Large mottled kidneys. These resemble the large white kidneys in every respect except that the cortex, instead of being white, is mottled in a variety of ways with white, yellow, red, and gray.

Fig. 10.—Vertical Section of the Cortex. Chronic Nephritis with Exudation.

3. Kidneys which resemble types one and two, but are not enlarged, the kidneys together not weighing over nine ounces.

The majority of the kidneys in chronic nephritis follow these three types.

4. Small kidneys, weighing together not more than five ounces, the capsules adherent or not, the surfaces nodular, the cortex thin, atro-

phied, white, the pyramids rather large and red. These kidneys belong to persons who have had symptoms of kidney disease for many years, with periods of apparent recovery.

5. Kidneys which have the ordinary appearance and consistence of the chronic congestion due to heart disease, but in addition the capsules are adherent and the surfaces finely nodular.

6. Kidneys of different sizes—large, medium-sized, and small, with adherent capsules and nodular surfaces. The cortex is gray, or gray

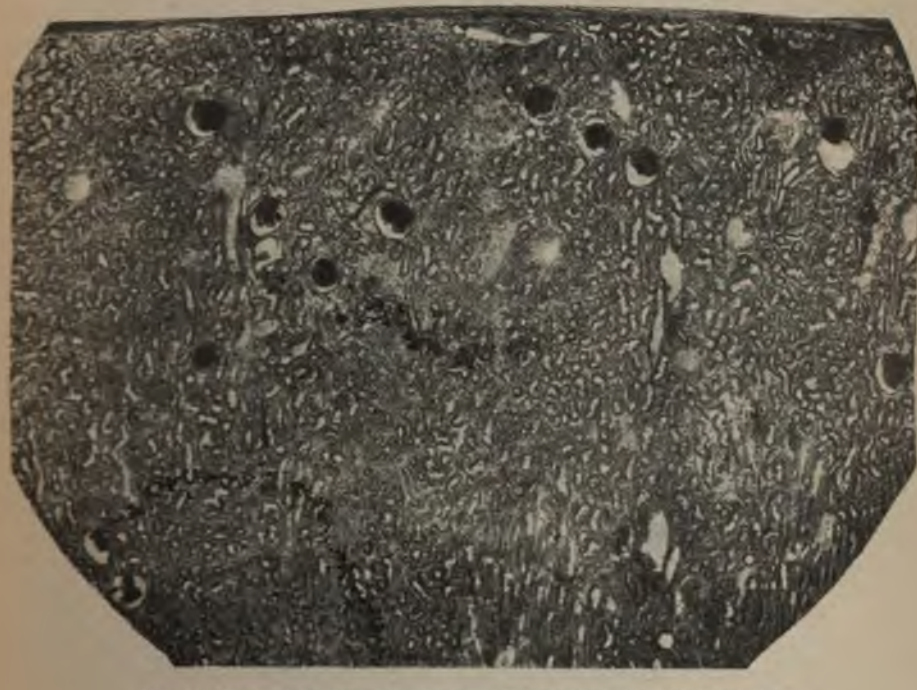

FIG. 11.—Vertical Section of the Cortex. Chronic Nephritis with Exudation.

mottled with red. The kidneys do not look at all like the large white kidneys. This is a type of frequent occurrence.

7. Kidneys which in their size, color, and general appearance are hardly to be distinguished from normal kidneys, except that their capsules are adherent.

8. Kidneys of small size, weighing together not more than four ounces, with adherent capsules. The cortex is atrophied, red, and irregular. These kidneys are found in persons who have given symptoms of renal disease for a number of years.

It might naturally be supposed that such marked differences in the gross appearance of the kidneys would correspond to equally

marked differences in the clinical histories and minute lesions. This, however, is not the case. The clinical histories are practically interchangeable, and the minute lesions are essentially the same.

Microscopical Appearances.—If we make vertical sections of the cortex of all these kidneys, no matter what their size or color, we get with a low magnifying power the same general picture. Instead of the uniform and orderly arrangement of tubes and glomeruli which we see in the normal kidney, the tubes seem to be obliterated in some

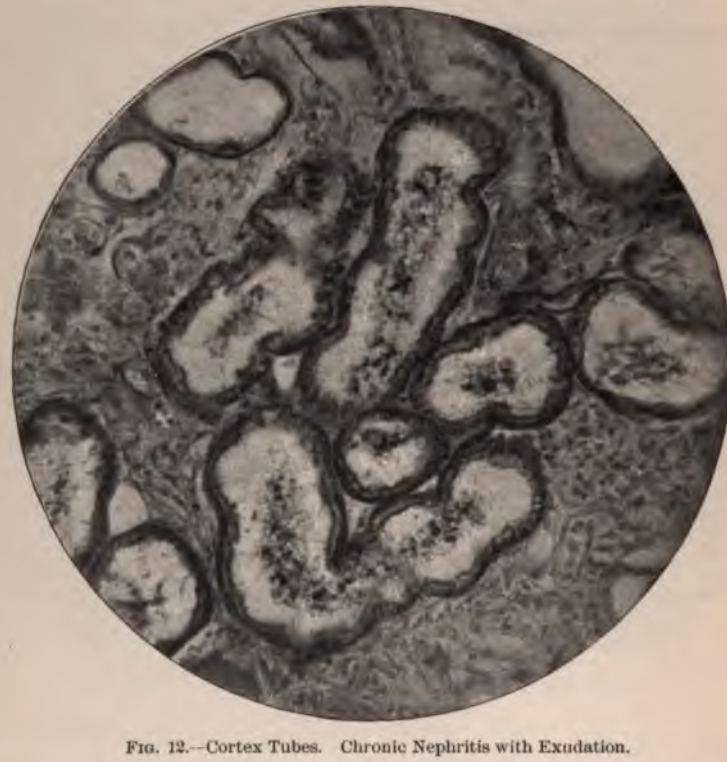

FIG. 12.—Cortex Tubes. Chronic Nephritis with Exudation.

places and dilated in others. There is a growth of fibro-cellular tissue in regular wedges, in irregular patches, or diffuse between the tubules.

If we examine the different constituents of the kidney in detail we find:

The tubes are in some places of normal size, in some places atrophied, in some places dilated. The atrophied tubes are in the patches of new connective tissue. The dilated tubes are not very large, nor do they form cysts.

The epithelium of the tubes is in some places merely flattened.

These tubes are empty, or contain coagulated matter, casts, and red and white blood-cells. In other tubes the epithelium is more or less swollen, sometimes so much so as to completely fill the tubes. In still other tubes the epithelial cells are swollen, their reticulum is very coarse with large meshes, and they are infiltrated with fat. The kidneys vary as to which of these changes in the epithelium predominates, but all of them may be found in the same kidney.

The new connective tissue is in the form of wedge-shaped masses

FIG. 13.—Cortex Tubes. Chronic Nephritis with Exudation.

in the cortex which follow the line of the straight arteries and veins, or it is in irregular masses, or it is arranged diffusely so as to separate the tubes from each other. The longer the nephritis lasts, the greater is the quantity of new connective tissue. The relative proportion of basement substance and cells and the density of the basement substance vary in the different kidneys. The new tissue is well supplied with blood-vessels.

The glomeruli are changed in several different ways:

1. They resemble the glomeruli in acute exudative nephritis.

They are large, the convolutions of the capillaries are seen with difficulty, there is a very great increase in the number of the cells which cover the capillaries, but these new cells are not of large size. We also see glomeruli, which apparently have been of this type, small and atrophied.

2. There is an increase not only in the number, but also in the size, of the cells which cover the capillaries. These cells are so large

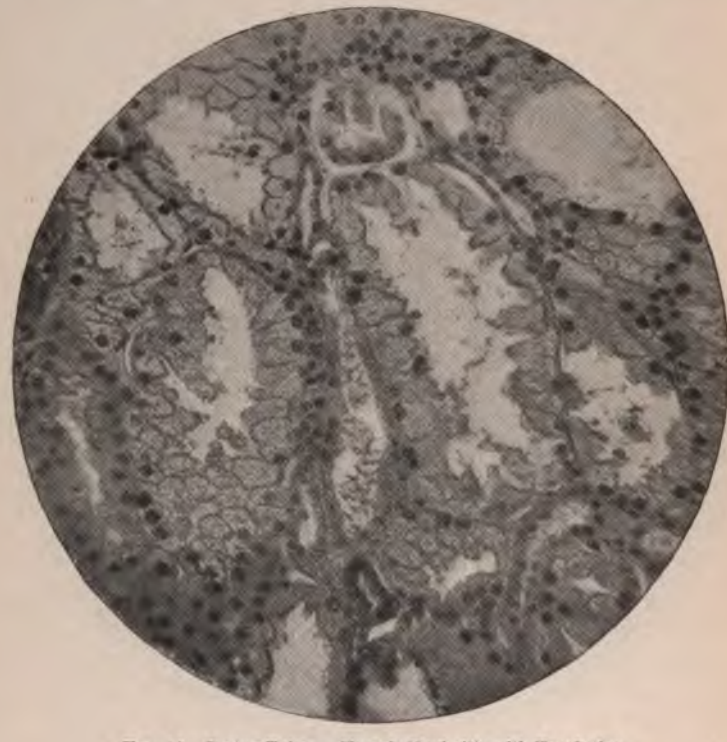

FIG. 14.—Cortex Tubes. Chronic Nephritis with Exudation.

that they project outward from the surface of the glomerulus. There is also an increase in the size and number of the cells within the capillaries. These glomeruli are found in all stages of atrophy.

3. The capillaries are changed in the same way by a growth of large cells on their outer surfaces and within them. In addition there is a very extensive cell-growth beginning in the cells which line the capsule. The mass of new cells produced in this way may be so great as to compress the capillaries. The glomeruli also become atrophied, the capillaries are shrunken, and the capsule cells changed into connective tissue.

4. If chronic congestion of the kidneys is followed by chronic nephritis, the dilatation of the capillaries due to the congestion continues, and there is added an increase in the size and number of the cells which cover the capillaries.

5. The walls of the capillaries are the seat of waxy degeneration, while the cells which cover them are increased in size and number.

6. Besides the atrophied glomeruli already described, there are

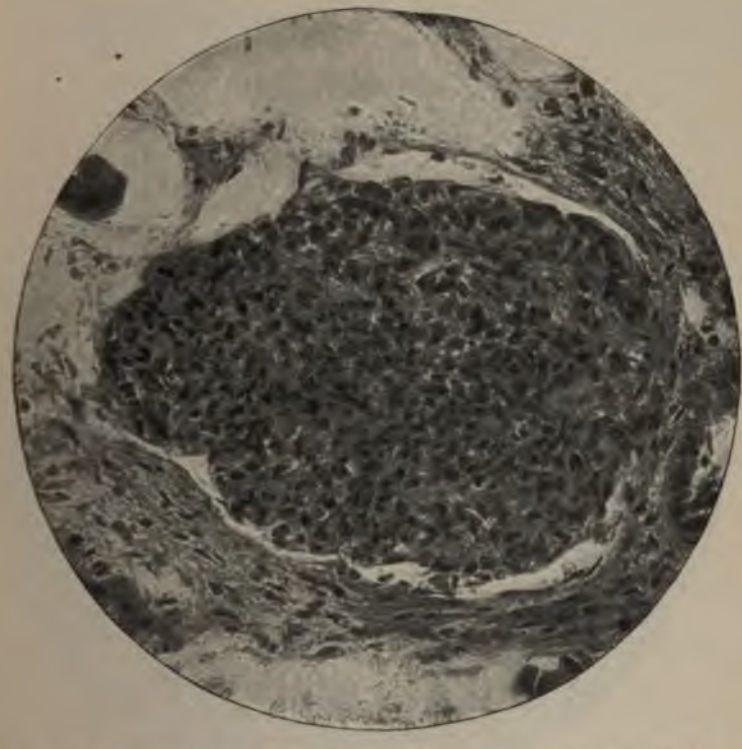

FIG. 15.—A Glomerulus with the Growth of Tuft Cells. Chronic Nephritis with Exudation.

others which are small and shrunken with comparatively little new growth of cells.

The arteries are not infrequently much altered by inflammatory changes. There is a growth of cells and basement substances from the inner surface of the artery which obstructs its lumen; or there is a thickening of each of the three coats of the artery; or all the coats of the artery are thickened and converted into a uniform mass of dense connective tissue; or the wall of the artery undergoes waxy degeneration.

Symptoms.

The urine varies in quantity at different times in the course of the disease. In the earlier periods the urine is often scanty or even suppressed. If the disease goes on rapidly the quantity of urine may continue small; if it goes on slowly the quantity is often increased. In some of the worst cases, with general dropsy, the patients will pass more than 100 ounces of urine a day.

The specific gravity and the proportion of urea to the ounce of

Fig. 16.—A Glomerulus with the Growth of Tuft Cells. Chronic Nephritis with Exudation.

urine slowly diminish as the disease progresses. This is the rule, but there are exceptions to it. In cases which improve, the quantity of urea, after being much diminished, may increase until the patient excretes the full normal quantity for the twenty-four hours.

In the cases of shorter duration the specific gravity is apt to run between 1.012 and 1.020. In the very chronic cases it will be between 1.001 and 1.005. A very low specific gravity indicates a large growth of connective tissue in the stroma of the cortex, or waxy de-

generation of the capillaries of the glomeruli and of the arteries of the kidney. Many persons who think that they have kidney disease get into the habit of drinking large quantities of mineral waters. This, of course, gives them urine of low specific gravity. In all doubtful cases it is necessary to determine the quantity of the whole excretion of urea for the twenty-four hours. There are patients in whom the quantity of urea is the principal factor in enabling one to decide between albuminuria without nephritis and chronic nephritis with exudation.

The urine regularly contains albumin and casts. During the

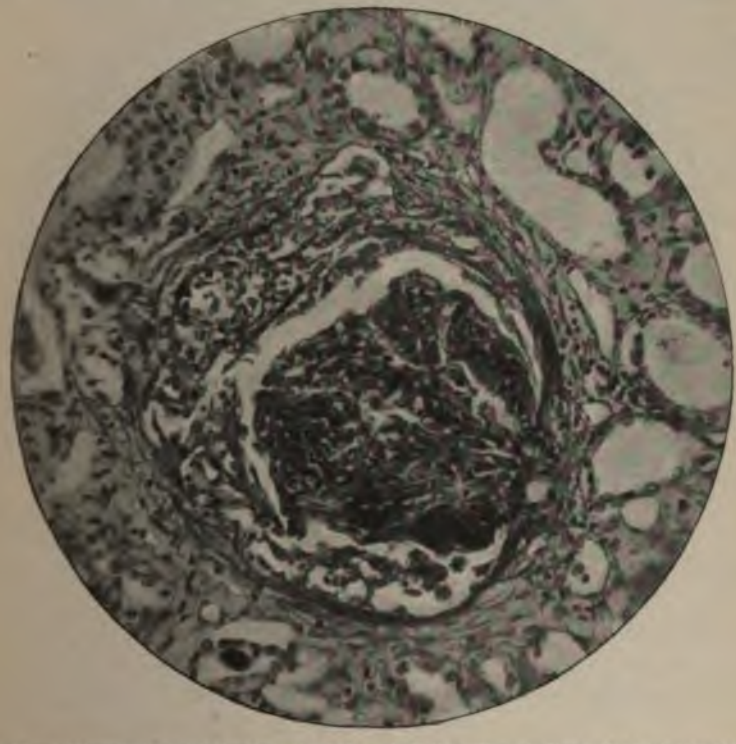

FIG. 17.—A Glomerulus with the Growth of Capsule Cells. Chronic Nephritis with Exudation.

active periods of the disease the quantity of albumin is very large; in the slow, prolonged cases the quantity is much smaller and at times it may disappear altogether. Generally speaking, with large quantities of albumin the patients are dropsical and anæmic; with small quantities of albumin they are anæmic but not dropsical. There seems to be a common cause for the exudation of serum from the blood-vessels throughout the entire body, the serum infiltrating the

tissues, accumulating in the serous cavities, and mixing with the urine.

The number of casts is regularly in proportion to the quantity of albumin, but there are exceptions to this rule.

A peculiar pallor of the skin and white color of the sclerotic is seldom absent. This gives to the patient a face very characteristic of chronic nephritis. In making a diagnosis in doubtful cases a good deal of importance is to be attached to the presence or absence of this

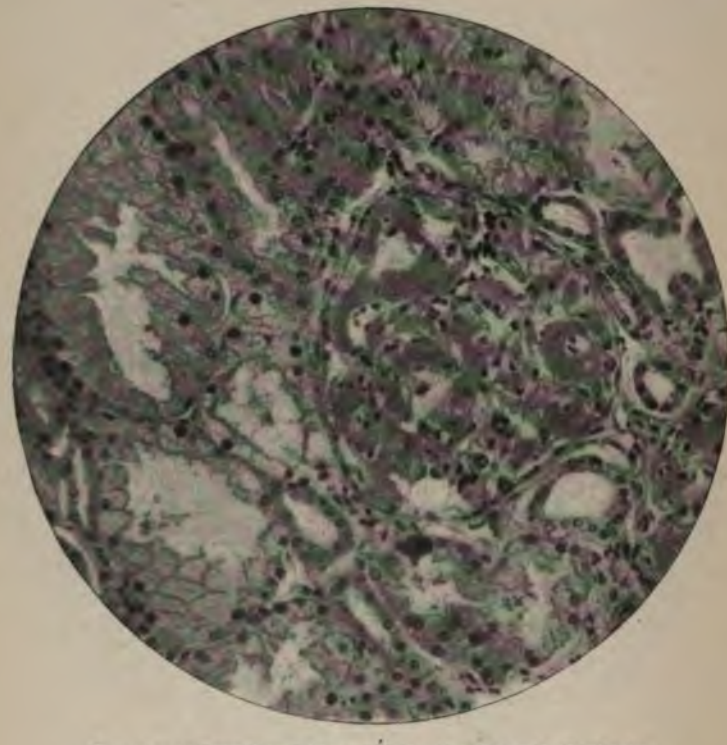

FIG. 18.—A Waxy Glomerulus. Chronic Nephritis with Exudation.

appearance of the face. The change in the color corresponds to a diminution in the quantity of hæmoglobin and in the number of red blood-cells. These changes in the blood are often not far advanced, but sometimes they are, and some patients even die with the symptoms of pernicious anæmia.

Dropsy may be considered almost a constant symptom of chronic exudative nephritis. There is an infiltration of the subcutaneous connective tissue with serum and an accumulation of serum in the serous cavities. The position of the fluid varies with that of the pa-

tient, accumulating in the dependent portion of the body. There is much variety as to the extent of the dropsy. In some patients there is never anything more than a moderate œdema of the legs, while in others a marked general dropsy is the most prominent symptom of the disease. There is also a variety as to the time of appearance and the duration of the dropsy. It may be one of the first symptoms of the nephritis, or it may not occur until late in the disease. When it is once established it may never leave the patient, or it may appear and disappear at irregular intervals.

Many of the patients are troubled with headache and sleeplessness. In some of them these symptoms exist only when the pulse is of high tension and disappear when the pulse becomes soft. In others, however, the headache and sleeplessness persist with a soft pulse. It must not be forgotten that these symptoms may also depend on digestive disturbances and not on the disease of the kidneys.

Acute uræmic attacks with contraction of the arteries, dyspnœa, vomiting, convulsions, etc., may occur at any time in the course of a chronic exudative nephritis. But they are of very much more frequent occurrence with the non-exudative form of the disease.

Chronic uræmia, on the contrary, is one of the ordinary ways in which an exudative nephritis proves fatal. The condition belongs to the later stages of the disease. It is developed rather gradually, but when once established is permanent, not disappearing up to the time of the patient's death. The patients are in a condition of alternating delirium and stupor, with a rapid, feeble, soft pulse.

Simple neuro-retinitis, or nephritic retinitis, may be developed at any time in the disease. Both eyes are regularly involved. The impairment of vision may be very slight, or considerable, or the patients may become entirely blind. With such a neuro-retinitis the prognosis of the nephritis is especially bad.

Dyspnœa is a nearly constant symptom, but it is not always the same kind of dypsnœa, nor produced by the same causes. It may be due to hydrothorax, to œdema of the lungs, to contraction of the arteries, or to failure of the heart's action.

The dyspnœa due to contraction of the arteries is common to both forms of chronic nephritis. It may be developed at any time during the course of the disease. It comes on in attacks, especially at night and in the early morning, and is worse when the patients lie down. It often begins while the patient is apparently in good health, but is a sure premonition of serious disease.

In some cases these attacks of dyspnœa can be controlled and the patient kept apparently well for months and even years. But as the attacks are repeated, they are more severe and more stubborn. The

heart's action fails in addition to the contraction of the arteries, and the dyspnœa becomes of such a character that it can only be relieved by death.

In other patients the first attack of dyspnœa is also the last. It cannot be relieved by any treatment and continues up to the time of the patient's death.

A catarrhal bronchitis with cough and expectoration is sometimes an annoying symptom. The cough fatigues the patient, and it is difficult to control it.

Loss of appetite, nausea and vomiting are frequent symptoms. When they do not already exist it is easy to cause them by the use of improper drugs.

The heart is very often affected. The disease of the kidneys after a time produces hypertrophy of the left ventricle. This does no harm until the time comes when the heart's action fails in spite of the hypertrophy, then the dyspnœa and dropsy follow.

Chronic endocarditis, chronic myocarditis, and dilatation of the ventricles are associated with chronic nephritis in two ways: they may cause a chronic congestion or degeneration of the kidney which is afterward followed by a nephritis; or the heart disease and kidney disease are developed in the same person, neither one of them secondary to the other. In these patients it is by no means easy to tell how much of the dropsy, the dyspnœa, and the loss of nutrition belongs to the heart disease and how much to the nephritis.

Course of the Disease.

There is hardly any limit to the variations of the disease, but the most constant symptoms are anæmia, dropsy, and albumin in the urine.

The following are some of the ordinary examples of this form of nephritis:

1. There are cases in which the symptoms are nearly continuous. The patients begin with anæmia, headache, disturbances of digestion, and a little dropsy. No one of these symptoms is at first very marked; the patient is not in bed, he does not feel very sick, but even at this time the urine contains a large quantity of albumin. As the weeks and months go on all the symptoms grow worse: the anæmia is more profound, the headaches and disturbances of digestion more troublesome, the dropsy involves more of the subcutaneous tissue and the serous cavities so that the patient becomes more and more helpless. There may be intercurrent attacks of acute uræmia with contraction of the arteries, or loss of eyesight, or a troublesome bron-

chitis. The ordinary duration of this form of the disease is from one to three years. The patients die with the most extreme dropsy, or in the state of chronic uræmia, or both these conditions exist together.

2. There are cases in which the anæmia, the dropsy, and the dyspnœa come on in attacks which last for weeks or months. Between the attacks the patients are comparatively well, often able to work, although the urine always contains albumin. These patients often go on for a number of years, better in the summer and worse in the winter. But each successive attack is more serious than the preceding, and finally there comes an attack from which the patient does not recover.

3. There are cases in which a number of years before death the patients have an attack of acute or subacute nephritis with anæmia, dyspnœa, dropsy, albumin in the urine, and all the usual symptoms. From this they apparently recover completely and seem to be in their ordinary health. The urine continues to contain a little albumin, or on some days the albumin disappears altogether. From year to year the specific gravity slowly falls. The exudation from the blood-vessels of the kidneys stops, but the chronic productive inflammation of the kidneys continues. Finally, after exposure, with an accident, with a pneumonia, or without discoverable cause, all the symptoms of a subacute nephritis are rather suddenly developed, and the patient soon dies.

4. There are cases which for years have no symptoms except pallor of the skin and mucous membranes, and urine of low specific gravity which habitually contains a moderate quantity of albumin. These patients must not be confounded with cases of simple anæmia, nor with those of persistent albuminuria without kidney disease. The diagnosis is sometimes quite difficult. The prognosis in these patients depends upon the specific gravity of the urine. If it is constantly below 1.010 the prognosis is bad, no matter how well the patients may feel.

5. There are cases in which the first symptom is the attack of spasmodic dyspnœa. This may continue and other renal symptoms rapidly develop. More frequently, however, the dyspnœa is palliated or relieved by treatment. The patient then goes on for months or years with occasional attacks of dyspnœa, each one more severe and harder to control, until finally other renal symptoms appear.

6. There are the cases complicated with endocarditis, myocarditis, or dilated heart. In these patients we have the association of cardiac and renal symptoms, either one predominating.

7. There are cases in which all the symptoms disappear, and the

urine returns to its natural condition. If this improvement continues for a number of years it seems probable that the nephritis has come to a standstill, and that enough kidney tissue has been left unimpaired to carry on the functions of the organ.

Treatment.

In the second and third group of cases just described the attacks are of acute or subacute character. The conditions calling for treatment are:

The nephritis;
The albuminuria;
The dropsy;
The headache and sleeplessness;
The nausea and vomiting;
The contraction of the arteries;
The anæmia;
The dyspnœa.

For the *nephritis* the patient should be kept in bed and placed on a fluid diet. He should have a hot pack twice a day, once a day, or every other day, as he will bear it. The most useful drugs are: morphine in very small doses, digitalin gr. $\frac{1}{100}$, and aconite ♏ i.–iij.

The quantity of *albumin* in the urine can be diminished by the hot pack and by the use of digitalin gr. $\frac{1}{100}$ four times a day.

The *dropsy* is favorably affected by the hot pack. It can be sensibly diminished by cathartics, of which elaterium is perhaps the best. But the effect of cathartics is temporary, and their administration cannot often be repeated.

For many patients digitalis in some form is the most useful drug for the dropsy, and it can be continued without injury for weeks and months. Favorable results are reported from the use of lactate of strontium in 30-grain doses four times a day, and from diuretin in 5-grain doses three times a day. In some patients caffeine, convallaria, or strophanthus will answer better than digitalis.

If there is much fluid in the serous cavities it should be drawn off with the aspirator. If the dropsy of the subcutaneous connective tissue is excessive the skin is to be pricked and the fluid allowed to drain off.

The *headache* and *sleeplessness* may exist with or without contraction of the arteries. If the arteries are not contracted, morphine in very small doses, codeine, or the bromides can be used. If the arteries are contracted morphine in larger doses and chloral are the best drugs.

The *nausea* and *vomiting* are controlled by the milk diet, or it may

be necessary to add an alkali to the milk, or to use peptonized milk or kumyss.

Contraction of the Arteries.—The character of the radial pulse and the heart's action are to be constantly watched. We do not wait for the dyspnœa, or vomiting, or convulsions to make their appearance, but as soon as the pulse shows an increased tension we begin with nitroglycerin, chloral hydrate, morphine, or potassium iodide. It is to be remembered that morphine in considerable doses can only be given to patients with this form of nephritis when the arteries are contracted. At all other times it is very easy to have dangerous and even fatal results with any preparation of opium.

The *anæmia* of chronic nephritis does not behave like simple anæmia. Iron is not a specific for it, although it may be of service. The greatest improvement in the anæmia is effected by the subsidence of the nephritis.

The *dyspnœa* is dependent either upon contraction of the arteries or upon dropsy. The treatment for it, therefore, is either the treatment of dropsy or the treatment of contraction of the arteries.

In these two groups of cases treatment carried on in these ways is often very satisfactory. All the symptoms subside and disappear. But it must be remembered that the kidneys have become changed in their structure, that a chronic productive nephritis still continues, that relapses and exacerbations are to be expected.

As the symptoms subside the patient gets back to a solid diet, is out of bed and then out of doors. If it is possible for him to spend the next two years in a warm climate where he can lead an out-of-door life, the probabilities of permanent improvement will be much greater.

In the first set of cases, those in which the symptoms continue and get steadily worse, treatment is very unsatisfactory. We try the measures that have just been described, but they are of no avail. We cannot even alleviate symptoms, the drugs do not help at all. After a time it becomes evident that there is no use in continuing plans of treatment which do nothing, and we employ very little treatment.

The fourth set of cases have no acute attacks, no great change in the general health, nothing but the anæmia and the changes in the urine. The management of these cases requires much judgment.

The patients should have a liberal and varied diet and yet every form of indigestion is to be guarded against. They do best if they can live in a warm climate all the year round. But even in an unfavorable climate they need out-of-door exercise. The drugs indicated are those for the relief of indigestion, and the preparations of iron.

The patients who begin with attacks of dyspnœa, without other renal symptoms, can often be relieved and enabled to work for a number of years. The dyspnœa is associated with a pulse of high tension; if we can relieve this the dyspnœa disappears. The best drugs for this purpose are nitroglycerin, chloral hydrate, and potassium iodide.

In the cases with chronic endocarditis, myocarditis, or dilatation of the ventricles, the management of the heart's action becomes a matter of great importance.

Chronic Productive Nephritis without Exudation.

Definition.

A chronic inflammation of the kidney attended with a new growth of connective tissue in the stroma, permanent changes in the glomeruli, degeneration of the renal epithelium, and sometimes changes in the walls of the arteries.

Synonyms.—Chronic Bright's disease; Cirrhosis of the kidney; Granular degeneration; Interstitial nephritis; Chronic indurative nephritis; The arterio-sclerotic kidney.

Etiology.

While this form of nephritis is especially common in persons over forty-five years old, it is by no means rare in young adults, and is occasionally seen in children.

It seems to be caused by chronic alcoholism, lead poisoning, gout, and by the same conditions as those which cause emphysema, endocarditis, and cirrhosis of the liver. It follows chronic congestion of the kidney, hydronephrosis, and chronic pyelitis.

Morbid Anatomy.

The Kidneys.—The larger number of the affected organs are found after death to be diminished in size; the two kidneys together may not weigh more than two ounces. The capsules are adherent; the surfaces of the kidneys are roughened or nodular, the cortex is thin and of a red or gray color.

A considerable number of these kidneys, however, do not differ in their size or appearance from normal kidneys, except that their capsules are adherent and their surfaces roughened.

Occasionally the kidneys are large, weighing together from 16 to

32 ounces, with smooth or nodular surfaces, and a cortex of red, gray, or white color.

If the nephritis follows chronic congestion, the kidneys remain hard, but the cortex becomes thinned, the capsules adherent, and the surface roughened.

There is a growth of new connective tissue in the cortex and also in the pyramids, which becomes more and more extensive as the disease goes on. In the cortex the new tissue follows the distribution of the normal subcapsular areas of connective tissue, is in the form of

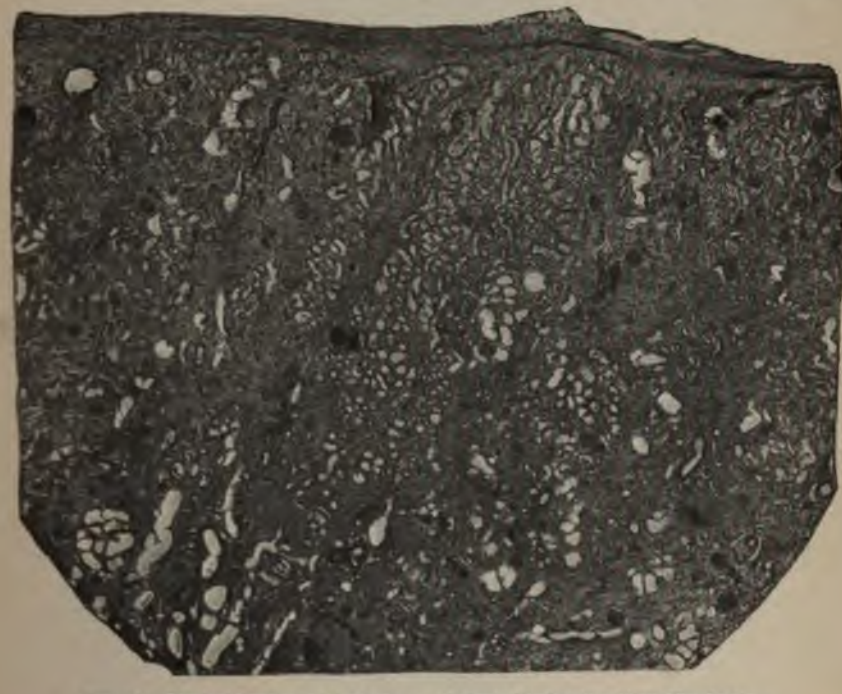

FIG. 19.—Vertical Section of the Cortex. Chronic Nephritis without Exudation.

irregular masses, or is distributed diffusely between the tubes. In the pyramids the growth of new connective tissue is diffuse.

The tubes, both in the cortex and pyramids, undergo marked changes. Those included in the masses of connective tissue are diminished in size, their epithelium is flattened, some contain cast matter, many are obliterated. The tubes between the masses of new connective tissue are more or less dilated; their epithelium is flattened, cuboidal, swollen, degenerated, or fatty. The dilatation of the tubes may reach such a point as to form cysts of some size, which contain fluid, or coagulated matter. These cysts follow the lines of systems of tubes, or are situated near the capsules.

Of the *glomeruli* a certain number remain of normal size, but with the tuft cells swollen or multiplied. Many others are found in all stages of atrophy and of change into connective tissue. The atrophy seems to depend partly on the growth of tuft cells and intra-capillary cells, partly on the thickening of the capsules, partly on the occlusion of the arteries. If the chronic nephritis follows chronic congestion of the kidneys the glomeruli remain large, with an increased growth of tuft cells, or they become atrophied, but with the dilatation of the

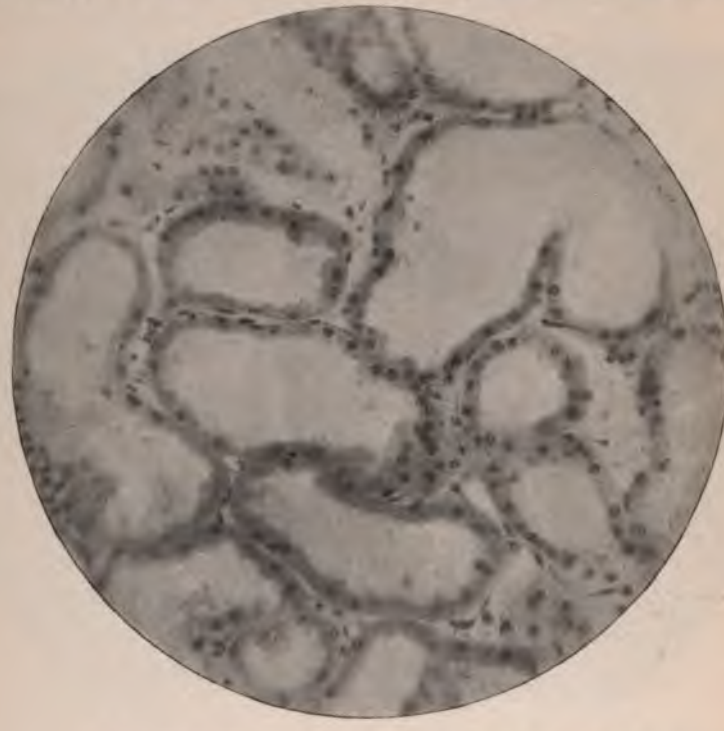

FIG. 20.—Cortex Tubes. Chronic Nephritis without Exudation.

capillaries still evident. The capillaries of the glomeruli may be the seat of waxy degeneration. The arteries exhibit the same changes as have already been described in speaking of chronic exudative nephritis.

COMPLICATING LESIONS.

Heart.—Hypertrophy of the left ventricle of the heart is frequently caused by exudative nephritis, but much more frequently by chronic nephritis without exudation. It must be admitted, however, that such an hypertrophy, although frequent, is not constant,

and that with both exudative and non-exudative nephritis there may be no change in the wall of the left ventricle. The hypertrophy of the wall of the ventricle may after a time be succeeded by dilatation, or chronic degeneration, or myocarditis.

Chronic endocarditis is often associated with this form of nephritis, apparently both lesions being produced by the same causes. It may also happen that chronic endocarditis causes first chronic congestion of the kidney and then chronic nephritis without exudation.

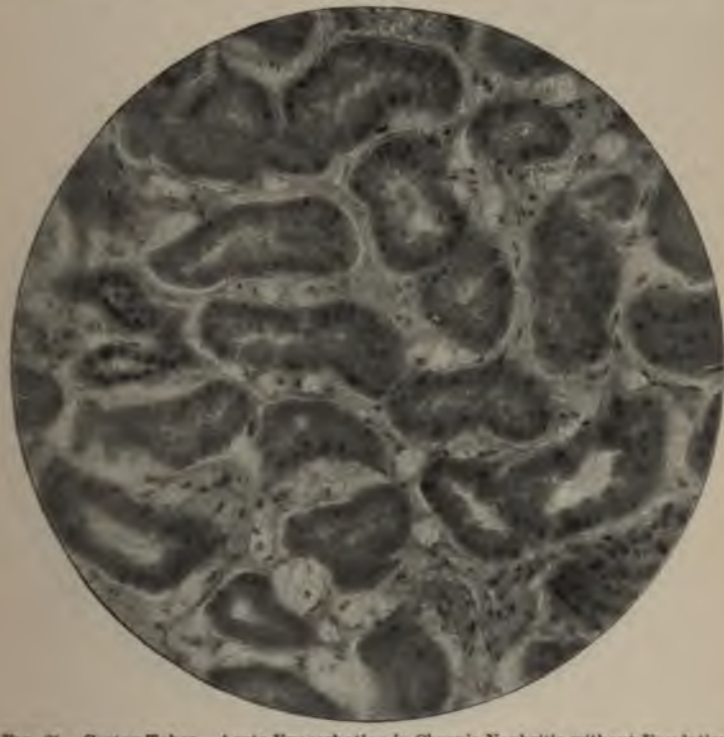

FIG. 21.—Cortex Tubes. Acute Exacerbation in Chronic Nephritis without Exudation.

Lungs.—Pulmonary emphysema and cirrhosis of the liver are frequently associated with chronic nephritis.

Arteries.—One of the most important of the complicating lesions is chronic endarteritis. The relationship between endarteritis or, more properly speaking, arteritis and nephritis, and the ways in which they are associated together are not as fully understood as they should be. The principal reason for this is the failure to recognize the fact that chronic inflammation of the walls of the arteries is just as much a disease as chronic endocarditis, or emphysema, or cirrhosis of the liver.

Arteritis.

Unquestionably arteritis is more often seen associated with other diseases than by itself. It must also be admitted that it is of such frequent occurrence in old persons that it is natural to think of it as a senile change. Still farther, the use of such names as arterio-capillary fibrosis and arterio-sclerosis have helped to prevent us from classing arteritis with the other chronic productive inflammations.

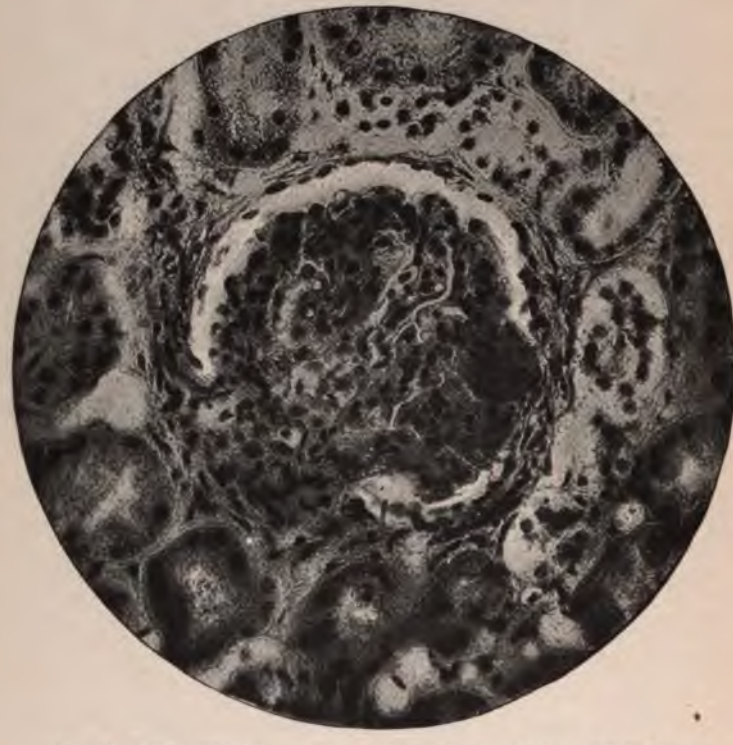

FIG. 22.—An Atrophied Glomerulus. Chronic Nephritis without Exudation.

Chronic inflammation may involve the entire aortic system of arteries, or it may be confined to a part of that system.

If only the arteries in some one part of the body are involved, then in that part of the body the blood supply is irregular or cut off, the diseased artery may become dilated, or it may rupture.

If a large part of the aortic system of arteries is involved, then the patients suffer from symptoms which seem to depend partly upon the changes in the arteries, partly upon attacks of contraction of the arteries, partly upon hypertrophy of the left ventricle of the heart

and heart failure, partly upon the obstruction to the passage of blood through the cerebral arteries.

The clearest idea of general arteritis as a disease is to be obtained by observing it in persons not over forty years old, who have no complicating lesions.

At first for a number of years these patients suffer only from impaired nutrition, a disposition to become anæmic, and attacks of dyspnœa. It can be seen and felt that the walls of the temporal and

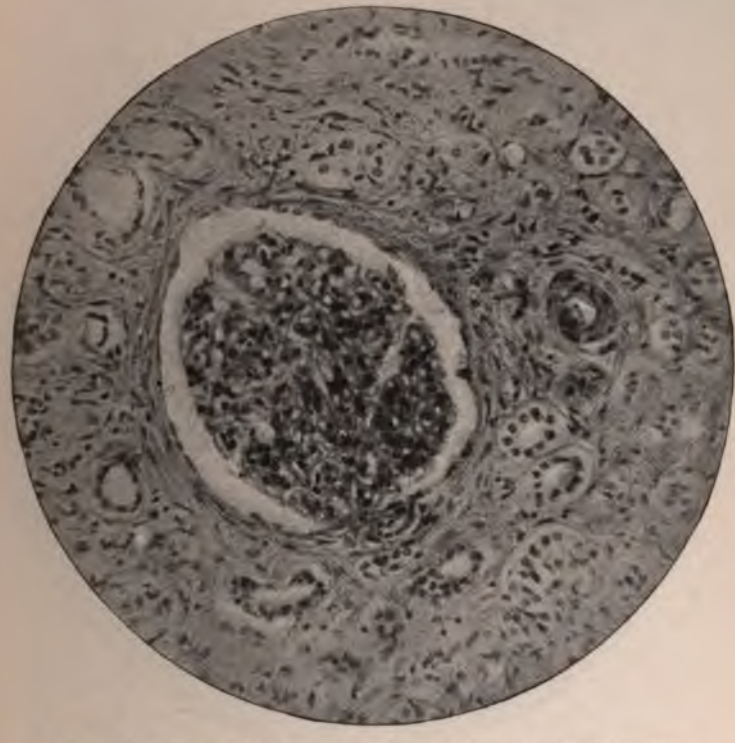

Fig. 23.—An Atrophied Glomerulus. Chronic Nephritis without Exudation.

radial arteries are thickened and that the left ventricle of the heart is hypertrophied. At the times when the patient has dyspnœa the tension of the pulse is much increased.

For a considerable length of time the nutrition and the anæmia can be improved by climate and by diet. The attacks of dyspnœa can be controlled by the drugs which dilate the arteries. But sooner or later the patients get worse. Some of them get up a dyspnœa that cannot be controlled, the action of the hypertrophied heart fails, and the patients, after suffering for weeks or months with the most dis-

tressing symptoms, die. In other cases death takes place with cerebral symptoms—sudden unconsciousness, or aphasia, or hemiplegia. After the death of these patients no lesions of any consequence are found except the changes produced by chronic inflammation of the walls of the arteries.

It is evident that the symptoms and death of these patients are due to the changes in the arteries, that the disease from which they have suffered is chronic arteritis. But it is also evident that their symptoms—loss of nutrition, anæmia, contraction of the arteries,

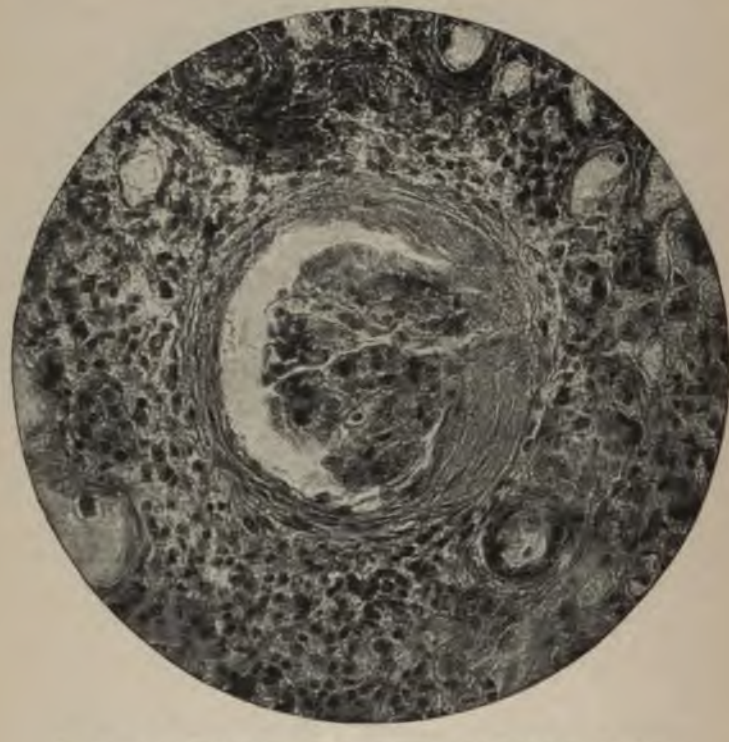

Fig. 24.—An Atrophied Glomerulus. Chronic Nephritis without Exudation.

hypertrophy of the left ventricle, dyspnœa, heart failure, unconsciousness, aphasia, hemiplegia—are also the symptoms of chronic nephritis.

Still further we find that many patients with these symptoms do have both arteritis and nephritis. In any given case with these symptoms, therefore, it is a matter of importance to determine whether the patient has arteritis alone, or nephritis alone, or both diseases at the same time.

Patients who have chronic nephritis are more liable than are other persons to attacks of pericarditis, bronchitis, and gastric catarrh.

Symptoms.

The Urine.—The typical urine of chronic non-exudative nephritis is a urine increased in quantity, of a specific gravity of about 1.010, containing a diminished quantity of urea, without albumin or casts,

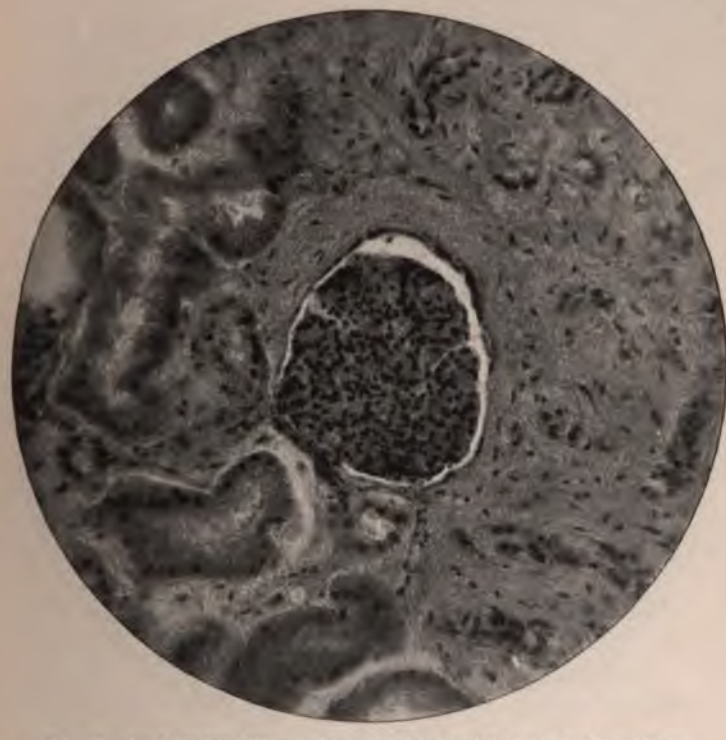

Fig. 25.—An Atrophied Glomerulus. Chronic Nephritis without Exudation.

or with a trace of albumin and very few casts. But exacerbations of the nephritis and changes in the circulation may for a time considerably increase the quantity of albumin and the number of casts.

Very important modifications of the urine, however, are of ordinary occurrence. It is quite possible with nephritis of this type far advanced to have urine not below 1.023 in specific gravity and without albumin or casts. When one sees this urine during life and then the kidneys after death it is difficult to understand how they can belong to each other.

On the other hand there are cases in which the specific gravity of the urine falls almost to 1.000, either with or without waxy degeneration of the blood-vessels. In some cases the quantity of urine is very much increased—several quarts in the twenty-four hours. During the attacks of contraction of the arteries, to which these patients are liable, the urine may be diminished to a few ounces or even suppressed.

Cerebral Symptoms.—In a great many of the cases cerebral symptoms are developed at some time in the course of the disease.

FIG. 26.—An Atrophied Glomerulus. Chronic Nephritis without Exudation.

Headache and sleeplessness are often present, the headache sometimes so severe and continuous that the patient is nearly maniacal. Instead of the headache there may be neuralgic pains in different parts of the body.

Muscular twitchings and general convulsions are much more serious. They may be early symptoms, or not occur until late in the disease.

Hemiplegia, with or without aphasia, may be the first symptom

to call attention to the nephritis, or may not occur until later in the disease. The invasion of the hemiplegia is sudden and is usually accompanied by coma. There is loss of motion alone, or of both motion and sensation. The hemiplegia, aphasia, and coma may continue up to the time of the patient's death, or disappear after a few hours or days. In the latter case the patient may have several such attacks. These attacks have been ascribed to localized œdema of the brain. In the cases which I have seen there were no changes in the brain tissue, but the cerebral arteries were damaged by chronic arteritis.

Delirium, mild or violent, stupor, and coma may come on in sudden attacks, or be developed slowly and gradually.

When these cerebral symptoms come on in attacks the pulse is of high tension, the temperature is raised, and the patients are said to suffer from acute uræmia. Very often they recover from a number of these attacks. In the fatal attacks the pulse often loses its tension and becomes rapid and feeble; the patients die comatose with a feeble heart.

Instead of such acute attacks of cerebral symptoms, delirium and stupor may come on gradually in persons far advanced in their nephritis. The temperature is then apt to be below the normal and the pulse is rapid and feeble.

Temporary blindness, neuro-retinitis, or nephritic retinitis are developed in a moderate number of the patients.

Chronic bronchitis and emphysema very frequently exist and their symptoms often form a large part of the clinical history.

Attention has already been called to the large share that chronic arteritis may have in the production of some of the renal symptoms.

The Heart.—The left ventricle of the heart regularly becomes hypertrophied after the nephritis has lasted for several months. The disposition to hypertrophy is, I think, rendered greater by repeated attacks of contraction of the arteries and by complicating arteritis. The hypertrophy is usually easily made out. The patient remains unconscious of its existence, or has disturbances of sensation and palpitation. As the disease goes on the hypertrophied heart may become feeble, and then dyspnœa and the other evidences of feeble circulation make their appearance.

In the same way the complicating endocarditis, which so often exists, may give no trouble until the valves are a good deal changed, or the ventricles dilated, or the heart's action altered, or the arteries contracted; then the circulation is interfered with, and the results of venous congestion of different parts of the body show themselves.

Dyspnœa is a frequent symptom, often the first symptom noticed

by the patient. It is a spasmodic dyspnœa coming on in attacks, which last for minutes, hours, or days. It is made worse by bodily or mental exertion, or by the recumbent position. It does not resemble bronchial asthma. It is apparently due to the association of changes in the arteries and heart. It cannot be distinguished from the dyspnœa which is caused by arteritis without nephritis. With contraction of the arteries alone, or with a feeble heart alone, no dyspnœa may exist; but if the contraction of the arteries be so great that the hypertrophied heart cannot overcome the obstruction, or if with contraction of the arteries the heart becomes dilated or feeble, then the attacks of dyspnœa begin. At first the attacks are not severe and are of short duration, but if the mechanical conditions which cause them cannot be controlled, they become longer and more distressing.

The stomach may continue to perform its functions fairly well, but more often there is gastric indigestion, gastric catarrh, or spasmodic vomiting.

Dropsy as a rule is absent with non-exudative nephritis, unless it is complicated by chronic endocarditis, by cirrhosis of the liver, or by the disturbances of circulation which come on later in the nephritis.

Profuse bleeding from the pelvis of atrophied kidneys is sometimes seen. In all cases, after a time, the nephritis exerts its effects upon the nutrition of the patient, and the flesh and strength are diminished. On the other hand, the patients do not usually become so pale as they do with an exudative nephritis.

Course of the Disease.

It is characteristic of the chronic productive inflammations of the lungs, the heart, the arteries, the liver, and the kidneys that, while they often exist as serious and fatal diseases, they may also exist as lesions and yet do not interfere with long life and apparent good health. This seems to depend, at least in part, on the rapidity with which the inflammatory changes in these different parts of the body are developed. If the development is slow enough, the functions of the organ continue to be performed in spite of the new growth of connective tissue.

We have to admit that in all cases of chronic non-exudative nephritis a period of weeks, or months, or years elapses during which the changes in the kidney are slowly going on, and yet the patients seem well and are not aware that they have any disease. How far the nephritis can advance and how many years it can exist before the symptoms of it appear, it is difficult to say. We see a great many different stages in the development of the nephritis in persons who die from other diseases and have never given any renal symptoms.

The nephritis is of slow development, gradually altering the structure of the kidney more and more, so that we should expect that the symptoms of the nephritis would also be developed gradually. This is very often the case, but quite as often the nephritis will advance without symptoms up to a certain point and then the patient suddenly becomes ill.

A. Cases with Slow Development of Symptoms.—Of the patients in whom the symptoms are gradually developed we may distinguish:

1. Patients who gradually develop hypertrophy of the left ventricle of the heart, with a lowering of the specific gravity of the urine, and a pulse that is easily made too tense, otherwise their health is good. We often watch these persons for many years, expecting other renal symptoms. But the symptoms do not come, and the patients die of some other disease.

2. Patients who have digestive disturbances, and gradual loss of flesh and strength. The urine is of low specific gravity and increased quantity, or the specific gravity and quantity remain almost normal; often from time to time there are traces of albumin and a few hyaline casts. These patients are often very puzzling. From year to year they slowly get more feeble and more emaciated; the digestive disturbances are sometimes better and sometimes worse. Occasionally there is an interval of great improvement so that the patients think they have entirely recovered. As the disease lasts a long time the patients are apt to see a number of physicians and get a number of opinions, for the diagnosis is really a difficult one. Some of the patients die from intercurrent diseases, but others go on and die simply exhausted with nothing but the chronic nephritis.

3. Patients who for months or years have attacks of spasmodic dyspnœa and between these attacks are comparatively well. The patients are usually over forty years old. The attacks of dyspnœa are apt to come on in the early morning and go off later in the day. Often chronic arteritis, or chronic endocarditis, exists at the same time. For a while the attacks of dyspnœa can be relieved, and the patients are capable of mental and physical exertion and feel quite confident of recovery. But as the attacks of dyspnœa recur they last longer and are harder to relieve. Finally comes the time when the dyspnœa cannot be relieved. It lasts day and night, the patients cannot lie down, the scrotum and legs become œdematous, and death hardly comes soon enough to relieve their distress.

4. Patients who have symptoms progressing for several years. At first vomiting, or headache, or neuralgic pains. Then dyspnœa, a little dropsy of the legs, and loss of flesh and strength. Finally death from exhaustion, or with an attack of convulsions, or in coma.

5. Patients in whom the symptoms come on in attacks, each attack worse than the preceding, and the general health more and more impaired between the attacks. During the attacks there are headache, sleeplessness, delirium, stupor, coma, convulsions, dyspnœa, vomiting—sometimes one, sometimes another the prominent symptom. The tension of the pulse is considerably increased. The urine is of low specific gravity and often contains a little albumin. Between the attacks the patients at first seem to be fairly well, but later they gradually lose flesh and strength. The urine between the attacks is of low specific gravity and contains little or no albumin. The patients finally die in one of the attacks.

B. Cases with Rapid Development of Symptoms.—Of the patients who are apparently in their ordinary health until there is a violent invasion of symptoms, we may distinguish those in whom the attack seems to be precipitated by an injury or an intercurrent disease, and those in whom it comes on without discoverable cause. In either case the attack regularly takes the form of cerebral symptoms, or of dyspnœa, or of vomiting, or of sudden death. During these attacks the tension of the pulse is high, the urine is diminished in quantity or suppressed and often contains a little albumin.

1. The cerebral symptoms are: general convulsions, coma, hemiplegia, and aphasia. The convulsions come on suddenly, they are repeated several times, between them the patients are unconscious. Many of the patients die with the convulsions, but a few recover. We are apt to see these persons for the first time while the convulsions are going on, and are told by their friends that they were in their ordinary health until the convulsions began.

The coma is developed in the same rapid way. The patient is found in bed, in a room, or in the street, at first stupid and muttering incoherently, then completely comatose. From this coma they do not emerge, but go on and die in a few hours or days.

The hemiplegia is like that with a clot or with an obstructed artery. The patient falls to the ground unconscious and hemiplegic. If the hemiplegia is on the right side there is usually aphasia. The paralyzed side of the body may remain quiet, or become rigid, or be moved involuntarily. The hemiplegia and unconsciousness usually continue up to death. But occasionally we see a patient who recovers both motion and consciousness.

2. The dyspnœa often starts with an ordinary bronchitis. The patients cannot lie down, they suffer from the constant feeling of dyspnœa, the pulse is full and tense, the drugs which usually dilate the arteries are of little or no effect, the scrotum and legs become œdematous. The patients live only a few weeks.

3. The vomiting may at first resemble that of an acute gastritis, or that caused by some irritating substance in the stomach. But it continues, it is exhausting, it does not yield to the ordinary remedies directed to the stomach; the pulse is full and tense. Such vomiting, however, can often be stopped by the drugs which dilate the arteries.

4. The patients after an injury, or a surgical operation, or without discoverable cause become feeble, the heart's action is feeble, the urine is diminished or suppressed, and in a few hours the patient is dead. These cases are not common. They are very disagreeable for the physician, as the patients seem to die without sufficient cause.

Treatment.

The progress of the nephritis can be favorably affected by attention to the diet and mode of life, and to climate. As regards the diet, the quantity of sugars and starches taken should be restricted, and the ingestion of fats encouraged. The use of wine, spirits, and tobacco should be discontinued. Exercise in the open air is to be advised as long as the strength permits of it. As regards climate, we must consult the idiosyncrasy of the patient; it should be a climate where he eats well, sleeps well, and feels well. There is a decided advantage in not remaining in the same place throughout the year.

In the patients belonging to group one, with urine of low specific gravity and hypertrophy of the left ventricle, it will be found that whenever the tension of the pulse is increased the patients do not feel quite so well. When this is the case potassium iodide will often soften the pulse and remove the discomforts. These patients can also be much improved by regulated exercise in the open air.

In the patients belonging to group two the treatment is directed to the digestive disturbances and the nutrition. The regulation of the diet and the mode of life, lavage of the stomach, relieving constipation, and increasing the production of bile are all of importance. When the production of urine is largely in excess of the normal, combinations of nux vomica and sodium bromide will sometimes act as a specific in reducing this undue quantity.

In the patients with attacks of spasmodic dyspnœa much can be done with the drugs which dilate the arteries and stimulate the heart. According to the tension of the pulse and the strength of the heart's action, we use these drugs separately or together. Chloral hydrate, nitroglycerin, and potassium iodide are the most reliable of the arterial dilators; digitalis, strophanthus, and caffeine are the best cardiac stimulants for this purpose.

The treatment of the attacks of headache, convulsions, coma,

hemiplegia, and vomiting is a matter of importance. The only working theory that one can go on is to believe that at the time of these attacks there is an irritant poison in the blood which causes contraction of the arteries, and that the cerebral symptoms are due partly to the contraction of the arteries and partly to the poison itself. What the poison is or whether it is in all cases the same poison we do not know.

Evidently the indications for treatment given by this theory are, first, to remove the poison from the blood and, second, to dilate the contracted arteries.

The plans which are ordinarily used to remove the poison from the blood are: general blood-letting, purging, sweating, and diuresis. These measures unquestionably can do much good. Whether they do so because they remove poison from the blood, or because they relieve the arterial tension, is a matter open for discussion.

Dilatation of the arteries can be effected by hypodermic injections of morphine; by nitroglycerin, chloral hydrate, and potassium iodide; and by sweating. Very often with these remédies the pulse will become soft and the cerebral symptoms will disappear. But after the nephritis has advanced beyond a certain point it is found that all these remedies are inert; the tension of the pulse and the cerebral symptoms continue. Or, instead of this, the pulse loses its tension, becomes rapid and feeble, the cerebral symptoms continue, and the patients die.

Puerperal Eclampsia.

During the later months of pregnancy, during labor, and immediately after childbirth women not infrequently become anæmic and dropsical, have albumin in the urine, and develop alarming cerebral symptoms—headache, blindness, convulsions, and coma.

These symptoms are especially frequent in primiparæ, in young women, and with twin pregnancies. They may be repeated in several successive pregnancies. They belong to the second half of pregnancy, increase in severity as the pregnancy advances, and are at their worst during labor.

Morbid Anatomy.

In women dying with cerebral symptoms and albuminuria at about the time of childbirth I have found the following conditions:

Normal kidneys;

Dilatation of the pelves and ureters;

Acute degeneration of the kidney;
Acute exudative nephritis;
Acute productive nephritis;
Chronic nephritis.

In some of the patients, even in young women, I have found well-marked disease of the cerebral arteries.

Etiology.

A number of theories have been entertained as to the causes of puerperal eclampsia. It must be confessed that none of them is satisfactory, and that the subject is still obscure. The most prominent explanations are as follows:

1. Pressure on the renal veins by the gravid uterus produces a chronic congestion of the kidneys, which interferes with their functions.

2. Pressure of the uterus on the ureters renders it necessary for the kidneys to secrete against a higher pressure so that they are unable to get rid of the proper quantity of excrementitious substances.

3. The kidneys are obliged to excrete waste products not only from the mother, but also from the enlarged uterus and the fœtus, and this extra work they are unable to perform.

4. It has been demonstrated in some cases that before the convulsions there is a diminished quantity of excrementitious products in the urine, and after the cessation of the convulsions an increase of these products; therefore the convulsions are due to the retention of these excrementitious substances in the blood.

5. That for some reason the patients have cerebro-spinal congestion.

6. That for some reason they have cerebro-spinal anæmia.

7. That the convulsions are of the nature of acute epileptic attacks due to irritation of nerves in the pelvis.

8. That the enlarged uterus acts as an irritant to the vasomotor nerves and so causes a contraction of the arteries throughout the body.

9. That the enlarged uterus causes irritation of the vasomotor nerves which supply the renal arteries; the contraction of the renal arteries causes death or degeneration of the renal epithelium; the changes in the renal epithelium render the kidneys unable to excrete poisonous substances; the accumulation of these substances in the blood causes the convulsions, etc.

10. There is at the time of childbirth in some women a toxic substance produced in some unknown way, which is not caused by any

change in the function of the kidneys, but which is capable of causing transudation of serum from the vessels, contraction of the arteries, acute degeneration of the kidneys, and acute nephritis. In other words, the changes in the kidneys are not the cause of the convulsions, etc., but they are the result of the same poison which produces the albuminuria and the cerebral symptoms.

Symptoms.

1. There is a considerable number of pregnant women in whose urine during the latter months of pregnancy albumin is present in appreciable quantities; they have no other symptoms and pass through labor without trouble.

2. There are women who, during the latter months of pregnancy, have scanty and albuminous urine, more or less dropsy of the legs, and become pale and anæmic. They may pass through childbirth safely and do well afterward, but some of them have a chronic nephritis dating from the pregnancy.

3. In a small number of women at about the time of childbirth, either before, during, or after labor, there are cerebral symptoms. In some of these women albumin has been present in the urine during the pregnancy; in others, besides the albuminuria, dropsy and anæmia have also been present; but in others the cerebral symptoms are suddenly developed without any premonitory conditions.

The cerebral attacks are characterized by nausea and vomiting, headache, blindness, muscular twitchings, general convulsions, stupor, coma, hemiplegia, a rise of temperature, a pulse of high tension, venous congestion of the skin; the urine is diminished in quantity or suppressed, and usually contains large quantities of albumin. The cases vary as to how many of these symptoms are present. A fair proportion of the patients survive these attacks, although the children usually die. In the fatal cases death takes place with general convulsions, with hemiplegia, or with coma.

After the termination of the labor and the disappearance of the alarming symptoms the anxieties of the obstetrician are at an end, but those of the physician begin. For in many of these women a nephritis originates during pregnancy, which continues afterward as a chronic inflammation and ultimately destroys life.

Treatment.

While there have been many different opinions as to the nature of puerperal eclampsia, there is a good deal of uniformity as to the treat-

ment. If the convulsions come on at about the end of pregnancy, it is generally agreed that labor should be brought on and the child delivered as soon as possible. Apart from this we try to unload the veins and dilate the arteries. This can be done by general bloodletting and by the use of nitroglycerin, chloral hydrate, and opium. In order to guard against the cerebral symptoms it is of more practical importance to watch the arteries and the heart than to test the urine for albumin.

Suppurative Nephritis.

Suppurative inflammation of the pelvis of the kidney and of the kidney itself occurs under several different conditions. It is the result of injuries; it is due to emboli; it occurs without discoverable cause; it is secondary to cystitis, the cystitis being due to stricture of the urethra, to stone in the bladder, to paraplegia, to operations on the urethra, bladder, and uterus, to gonorrhœa, or to enlarged prostate. Chronic suppurative pyelo-nephritis may be caused by the presence of calculi in the pelvis of the kidney.

1. Suppurative Nephritis from Injury.

Gunshot wounds, incised or punctured wounds, falls, blows, and kicks are the ordinary traumatic causes. If the injury be a very severe one, it causes the death of the patient in a short time; if it be less severe, suppurative inflammation may be developed.

The inflammatory process may be diffuse, so that the whole of one or both kidneys is converted into a soft mass composed of pus, blood, and broken-down tissue; or it is circumscribed, and one or more abscesses are found in the kidney, which may communicate with its pelvis.

Symptoms.—Rigors mark the beginning of the suppuration and are often repeated throughout its course. A febrile movement is developed, which is apt to assume the hectic character with sweating. There is often vomiting. There may be very severe pain referred to the region of the inflamed kidney. The urine is diminished or suppressed; it contains blood alone, or blood and pus. In the bad cases the patients pass into the typhoid state, become delirious, and die comatose, or with a rapid and feeble pulse. Or the disease is protracted, the patients become more and more emaciated, and finally die exhausted. In other cases the symptoms abate, the urine returns to its natural condition, and the patients recover.

Treatment.—The management of these cases is rather surgical

than medical. The external wound is to be treated antiseptically, and the suppurating kidney is to be incised or removed, as may be necessary.

2. Abscesses Produced by Emboli.

In ordinary endocarditis with vegetations on the valves it often happens that fragments of the vegetations become fixed in the branches of the renal artery. When this is the case white infarctions are produced.

With malignant endocarditis and with septic infections emboli find their way into the branches of the renal artery and set up circumscribed foci of suppurative inflammation. The kidneys become enlarged and are studded with little white points surrounded by red zones. These little white points are formed by an infiltration of pus cells between the tubes, followed by the death and breaking down of the kidney tissue. The bacteria of suppuration are found in these little abscesses.

Symptoms.—These embolic abscesses can hardly be said to have a clinical history. Whatever symptoms may belong to them are lost in those of the general disease from which the patient is suffering.

3. Idiopathic Abscesses.

These occur without discoverable cause. Only one kidney is involved. We find after death part of the kidney destroyed; the remaining portions contain abscesses; the pelvis is dilated and contains pus, the capsules are thickened, the suppurative inflammation may extend to the surrounding tissues so that sinuses are formed, and even perforations into the intestine or through the diaphragm. It is very difficult in these cases to tell whether the inflammation begins in the kidney or in its pelvis.

Symptoms.—The symptoms begin gradually and are for some time obscure. There are repeated chills and an irregular febrile movement. The patients lose flesh and strength, become anæmic, and are often troubled by nausea and vomiting. There is more or less pain over the inflamed kidney. After a time the pelvis of the kidney may be so much dilated as to form a tumor. If the pus escapes from time to time through the ureter, this tumor will vary in size. The urine at intervals contains pus and fragments of broken-down kidney tissue. If the suppuration extends, there will be sinuses running behind the peritoneum, or into the colon, or upward through the diaphragm. The disease is apt to last a long time. The patients are liable to have chronic nephritis of the other kidney, or waxy degeneration of the viscera.

Treatment.—The only plan of treatment is to cut down on the suppurating kidney and treat it as an abscess, or to remove it altogether.

4. Suppurative Pyelonephritis with Cystitis.

Both kidneys become inflamed. The pelves are congested and coated with pus or fibrin. The kidneys are swollen, congested, and studded with foci of pus. The smallest foci are not visible to the naked eye, but with the microscope we find collections of pus cells between the tubes, with swelling and degeneration of the epithelium within the tubes. The larger purulent foci look like white streaks or wedges running parallel to the tubes and surrounded by zones of congestion. The larger abscesses replace considerable portions of the kidneys.

The ureters in some cases are inflamed, their walls thickened, their inner surfaces coated with pus or fibrin. The bladder presents the lesions of acute or of chronic cystitis.

Etiology.—This form of nephritis seems to be always secondary to a cystitis, the infection extending from the bladder through the ureters to the kidneys. The cases of cystitis in which a suppurative nephritis is likely to be developed are those due to strictures of the urethra, stone in the bladder, operations on the urethra, bladder, and uterus, paraplegia, gonorrhœa, and enlarged prostate.

Symptoms.—When the nephritis occurs with cystitis due to stone in the bladder, strictures of the urethra, or operations on the genito-urinary tract, the symptoms are much the same. The patient has first the symptoms belonging to the cystitis, then he is attacked with chills and a rise of temperature. The chills are repeated, the temperature is irregular and accompanied by profuse sweating. There is a rapid change in the general condition of the patient, he becomes more prostrated and emaciated from day to day. The face is drawn and anxious, the tongue dry and brown, the pulse rapid and feeble; delirium is developed and the patient finally dies in the septic condition. The urine is diminished in quantity or suppressed; it contains blood, pus, and mucus derived partly from the bladder, partly from the kidneys.

Cases of suppurative nephritis due to a gonorrhœal cystitis are not common, but several of them have been observed. Murchison describes two cases, in both of which the cerebral symptoms were very marked—delirium, convulsions, and coma. I have seen one such case. The patient was a prostitute who came into the hospital with a specific vaginitis. After a few days she developed the symptoms of an acute cystitis; then, after a few more days, she was attacked with

chills and a rise of temperature, passed rapidly into the septic condition, and died. At the autopsy there were found acute cystitis, pyelitis, and numerous small abscesses in both kidneys.

When suppurative nephritis complicates the cystitis due to enlarged prostate, the symptoms are somewhat different. The patients are usually men over fifty years old. They have generally suffered from the symptoms of enlarged prostate, retention of urine either constant or intermittent, and more or less cystitis with pus and mucus in the urine. Sometimes, however, no such history is obtained; the patients assert that they have had no previous bladder trouble. The first symptom is a diminution in the quantity of urine, with the appearance of blood mixed with it, or the urine may be suppressed altogether. The blood may be present in considerable quantities so that the patients seem to pass blood instead of urine. The patients rapidly become prostrated and very anxious. There are usually no chills, and there may be no rise of temperature. The prostration becomes more marked, the pulse is rapid and feeble, the skin is cold and bathed in perspiration, and the patients die in collapse at the end of a few days. Or, instead of such a history, the patients may behave as if they were the subjects of septic poisoning.

Prognosis.—Suppurative nephritis secondary to cystitis is a very fatal disease; so far as I know all the patients die.

Treatment.—The treatment for these cases is altogether a preventive one directed to the cystitis. When the nephritis is once established we have no further control over the case.

Tubercular Nephritis.

The different portions of the genito-urinary tract—the kidneys, ureters, bladder, seminal vesicles, prostate, testicle, uterus, Fallopian tubes, and ovaries—may become the seat of a localized tubercular inflammation.

Such an inflammation may involve one of these organs, or several of them. If several of them are involved, they are on the same side of the body, usually the left side. The inflammation is attended with the growth of tubercle bacilli and the formation of tubercle tissue. The tubercle tissue soon dies and undergoes cheesy degeneration.

In the kidneys the inflammation begins in the mucous membrane of the pelvis and calyces and extends to the parenchyma, until a large part of the kidney is replaced by the degenerated new tissue. The cheesy masses may soften or become calcified, while the kidney tissue between them is converted into fibrous tissue more or less infiltrated with pus.

The other kidney, after a time, is apt to become the seat of the exudative form of chronic nephritis with waxy degeneration of the blood-vessels.

The tubercular nephritis may be complicated by tubercular inflammation of other parts of the genito-urinary tract on the same side of the body, by tubercular peritonitis, pulmonary tuberculosis, or general tuberculosis.

The disease is said to occur at all ages; it is most frequent in middle-aged persons. It occurs twice as often in men as in women.

Symptoms.

The urine usually, but not always, contains from time to time blood, pus, detritus, epithelium, shreds of tissue, and tubercle bacilli. When the other kidney has become the seat of chronic nephritis the specific gravity of the urine falls and albumin and casts are present.

Pain, either continuous or in paroxsyms, and tenderness are often present in the inflamed kidney. There may be hectic fever with night sweats; the patients gradually lose flesh and strength. The kidney may be enlarged so as to form a tumor which can be felt. After a time there are added the symptoms of tubercular inflammation of other parts of the genito-urinary tract, of tubercular peritonitis, of pulmonary phthisis, of waxy degeneration of the viscera, or of chronic nephritis of the other kidney.

The disease lasts, as a rule, for several years. Most of the cases terminate fatally, but it is possible for the inflammation to stop and for the patient to recover.

Treatment.

The proper treatment for tubercular nephritis is the removal of the diseased kidney. The practical difficulty is to make the diagnosis before other parts of the genito-urinary tract have become tubercular, or before the remaining kidney has become the seat of chronic nephritis.

We may hope that climate and feeding may have the same good effects on tubercular nephritis as they have on pulmonary tuberculosis.

New Growths of the Kidney.

The most important new growths of the kidney are those which belong to the classes of sarcoma and adenoma.

The sarcomata grow from the kidney itself, or from its pelvis.

They are composed of connective tissue with an excess of cells, with which may be mixed mucous tissue or muscular tissue. These tumors often reach a large size and may grow for a number of years before they cause death. They form a hard abdominal tumor which at first retains the position and shape of the kidney, but may finally become so large as to occupy a considerable part of the abdominal cavity.

They are found as congenital tumors, are rather frequent in infants and children, and are occasionally met with in adults.

The adenomata grow in the cortex of the kidney in the form of nodular tumors. They may follow the papillary or the tubular type. In some cases the tumor or tumors never attain any considerable size, are not malignant, and give rise to no symptoms. In other cases the tumors become much larger, and may then behave like malignant growths. These large tumors are very vascular. The adenomata which run a malignant course, with the formation of metastatic tumors, are often called carcinomata.

Symptoms.

The sarcomata and adenomata, so far as their symptoms are concerned, may conveniently be described together. In both of them there are four principal symptoms: a tumor, pain, hæmaturia, and loss of nutrition.

The tumor is appreciable as soon as it has reached a sufficient size. While it retains the natural position and outlines of the kidney the diagnosis is comparatively easy, but as the tumor becomes larger and adhesions are formed it becomes more difficult to distinguish it from other abdominal tumors.

Hæmaturia is present at some time in the disease in about half the cases. The hemorrhages may be very large with rapid anæmia and exhaustion, or moderate in quantity, or so little as only to be appreciable with the microscope. They are apt to recur at intervals of days or weeks.

The pain is referred to the situation of the diseased kidney. It is by no means a constant symptom, but it may occur early and be throughout a prominent feature. They are apt to come on in attacks and to radiate downward along the course of the ureter.

Loss of appetite, nausea and vomiting are troublesome symptoms in some of the patients.

The loss of flesh surely comes sooner or later, but it is curious in some cases how long the general health may remain unaffected, and how long life can be prolonged even with enormous tumors.

Treatment.

The same rule seems to hold good for these tumors in the kidney as for the same tumors in other parts of the body. If the kidney be removed while the growth is still small, the prognosis is fairly good. If it be not removed until the tumor is large or until metastatic tumors have been formed, the prognosis is bad.

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DISEASES OF THE KIDNEYS
(SURGICAL)
AND OF THE URETERS.

BY

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LONDON.

DISEASES OF THE KIDNEYS (SURGICAL) AND OF THE URETERS.

SURGICAL DISORDERS OF THE KIDNEYS.

During recent years a considerable number of diseases involving the kidney and its main duct have been brought within the reach of surgery, and no treatise, for the use of practitioners, relating to the disorders of this organ can have any claim to completeness which does not include this aspect of the subject. Medicine and surgery may here find a common ground where it is not always easy to define the respective domains of the physician and surgeon.

It will be my object to give a concise account of the surgery of these parts, as well as to describe the various proceedings of a more or less mechanical nature which are now recognized as applicable to either their cure or their relief. The affections to be considered include:

Injuries of the kidney.
Undue mobility of the kidney.
Perinephritic and nephritic suppurations.
Surgical kidney.
Renal fistula.
Hydro- and pyo-nephrosis.
Renal calculus.
Tubercular kidney.
Deformities and mal-positions of the kidney.
Hydatids of the kidney.
Tumors of the kidney.

To the diseases of the pelves and of the ureters, as far as it is possible, a separate section will be devoted.

Injuries of the Kidney.

Protected as they are, partly by bony walls, and more extensively by the muscles and fasciæ constituting the abdominal parietes, lesions of these organs are comparatively rare when we consider the

chills and a rise of temperature, passed rapidly into the septic condition, and died. At the autopsy there were found acute cystitis, pyelitis, and numerous small abscesses in both kidneys.

When suppurative nephritis complicates the cystitis due to enlarged prostate, the symptoms are somewhat different. The patients are usually men over fifty years old. They have generally suffered from the symptoms of enlarged prostate, retention of urine either constant or intermittent, and more or less cystitis with pus and mucus in the urine. Sometimes, however, no such history is obtained; the patients assert that they have had no previous bladder trouble. The first symptom is a diminution in the quantity of urine, with the appearance of blood mixed with it, or the urine may be suppressed altogether. The blood may be present in considerable quantities so that the patients seem to pass blood instead of urine. The patients rapidly become prostrated and very anxious. There are usually no chills, and there may be no rise of temperature. The prostration becomes more marked, the pulse is rapid and feeble, the skin is cold and bathed in perspiration, and the patients die in collapse at the end of a few days. Or, instead of such a history, the patients may behave as if they were the subjects of septic poisoning.

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New Growths of the Kidney.

The most important new growths of the kidney are those which belong to the classes of sarcoma and adenoma.

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tusion. The history of some of these cases and the circumstances attending them are often at first clouded by the insensibility of alcohol, and death is known to have occurred from a lesion which was never diagnosed, for the reason that nothing obvious was present to raise such suspicion.

Contused wounds of the kidney are for the most part occasioned by the application of considerable violence in the direction of the loins, as in falls from a height, crushes and squeezes as by carriage wheels, and the like. It sometimes happens that very severe lacerations of the kidney may be inflicted without any sufficient indication of the lesion being apparent for some time afterward, and the attention of the surgeon is not directed to what has actually occurred, until some of the secondary effects of extravasation of urine, inflammation, or hemorrhage appear upon the scene. Mr. Henry Morris, to whom we are so largely indebted for developing the surgery of the kidney, records[1] a case of this kind "where the patient was unable to give any explanation of the onset of his illness and denied any recollection of having had an injury, but it is probable that while intoxicated he met with an injury to his side." After a somewhat vague illness of five weeks' duration Mr. Morris saw the patient in consultation, and diagnosing kidney trouble made an exploratory incision in the left ilio-costal region. A very large amount of blood clot was discovered in the retroperitoneal space, when it was ascertained that the source of the hemorrhage was a deep rent on the anterior surface of the kidney. As it was probable that fresh bleeding would occur, the kidney was removed, and the patient made a good recovery.

Pathologically speaking, kidney lesions present every variety in degree, from very small abrasions of the cortical substance accompanied by slight and transient hæmaturia to the tearing of the organ almost completely across. One or two illustrations, as indicating points in diagnosis and treatment, may be given.

Case.—A dock laborer, aged 42, was in the summer of 1865 admitted into the Liverpool Northern Hospital under my care, for an injury to his back, caused by falling down the hold of a steamship on to the edge of a case of goods. The patient was much collapsed, and there was a contusion in the right lumbar region, without any breach of surface. On partially recovering from his collapse, in the course of a few hours, he passed urine deeply discolored by blood and small clots. On the day following the injury the urine contained some long worm-like clots which had been moulded within the ureter. These were not present after the third day. In addition, by the microscope, blood-casts of the uriniferous tubes were occasionally seen. The patient's condition gradually improved, though the urine showed traces of blood for nearly three weeks.

In injuries involving a lesion of an internal organ we recognize in the collapse that follows a provision for favoring the process of clotting by which the vessels are sealed and excretion is suspended. The latter is important, for if the laceration were sufficient to permit of urine escaping into the tissues about the kidney, damage would be done, such as is seen when this secretion is elsewhere extravasated. For some time afterward the injured kidney must be little else than a percolator of water, minus the urinary salts, the excretion of the latter being provided for by a compensating action on the part of the opposite organ. It is to the immediate plugging of the renal blood-vessels, coupled with the fact that, if time is allowed, the uninjured organ is capable of doing double duty, that so many recoveries take place after rupture of the kidney. Hence we prefer to meet the collapse attending this injury by warmth, in the shape of hot blankets and sinapisms, which by determining blood to the skin favors repair. The bleeding from a lacerated kidney usually subsides spontaneously, but when considerable its arrest may be aided by gallic acid, matico, or ergot.

Dr. H. G. Rawdon reports a case [2] which I had the advantage of seeing with him, and which, in connection with the treatment of extensive ruptures of the kidney, was, at the time of its occurrence, unique.

Case.—A boy aged 12 years was admitted into the Liverpool Children's Hospital on Dec. 7th, 1882, having the day previously fallen out of a window a distance of eight feet. On admission he was suffering from pain in the side and there was blood in the urine. The hæmaturia continued and there was much difficulty in urination from blood-clots. As these symptoms continued and cystitis supervened, on the seventeenth day after the injury the right kidney was cut down upon and found imbedded in a mass of clots. On these being cleared away the organ was found almost divided into two equal portions by a transverse laceration. The torn portions were ligatured and removed by scissors. The operation was followed by considerable relief and urine was freely secreted. The cystitis, however, did not abate, and as the bladder appeared to be blocked with blood clots, lateral cystotomy was performed four days after the nephrectomy, which permitted the removal of a coagulum about the size of a walnut. Two days after this it is reported that a large irregular-shaped clot, partially disorganized and fœtid, was passed by the wound. The patient, however, gradually sank and died twenty-four days after the nephrectomy. At the autopsy the opposite kidney was found enlarged, and on section showed numerous points of suppuration. Both the pelvis of the kidney and corresponding ureter were considerably dilated and filled with pus. The condition of the remaining kidney undoubtedly caused the death of the patient. It was also equally clear that the state of the bladder was alone

responsible for the suppurative nephro-pyelitis which had ensued and caused death.

Though it is easy to be wise after an event, this instructive and important case indicates that, had nephrectomy been earlier performed, the hemorrhage and clotting within the bladder would have been prevented. In the latter was to be found the cause of the cystitis and urinary obstruction which eventually caused the destruction of the remaining kidney by disseminated suppuration.

Wounds of the kidney, as, for instance, those inflicted for surgical purposes, are occasionally, though rarely, followed by acute symptoms of septic poisoning of an exceptional nature. Mr. Dobson[3] has recorded a typical example which I will quote.

CASE.—"The case was that of a married woman, aged 35, who had for some time been treated for painful bladder troubles; she was admitted into hospital, with a swelling in the left loin, connected with the kidney and probably due to pus. I incised the kidney with antiseptic precautions, letting out pus which was in the pelvis, and after examining the interior of the organ with my finger, inserted a drainage tube. The operation took place at 1:30 P.M. and occupied only a few minutes; at 4:30 she was taken with a violent rigor, and at 5 o'clock her temperature was 106.4°. A dose of 15 grains of quinine was administered, and her temperature fell to 105° at 6:30; 104° at 7:30; 103° at 8:30; rose to 104° at 10:30, and fell again to 103.2° at 12 P.M. She died at 5 A.M., about sixteen hours after the operation. There was neither loss of blood nor shock. The external wound, which was small, was dressed antiseptically."

The case is not only of importance as a record, but as showing that the phenomena of urethral fever are not limited to lesions of the male urinary passage.

Movable Kidney.

A kidney which is unduly movable either by reason of the presence of a mesonephron permitting it to float, or in consequence of the loosening of its natural attachments to the abdominal parietes by whatever means it may be caused, is often a considerable source of discomfort to the individual. Without discussing the pathology of the subject and the varieties it presents, I would lay stress on the frequency with which the painful form of the disorder is traceable to a previous injury.

Instances often come under observation of persons suffering from it as a result of violent concussions to which the body has been subjected. Hence the importance of rest and support in all cases where injuries of this kind have been sustained. I had a gentleman under

observation who suffered much inconvenience from a movable kidney, which was not complained of before he had a severe fall from his horse. Mr. Bruce Clarke ' has drawn attention to the resemblance between what he describes as acute renal dislocation and the paroxysms of renal colic.

A kidney which moves about from whatever cause sometimes provokes symptoms of much distress to the patient—symptoms which, though often attributed to dyspepsia, have this peculiarity that no medicine for indigestion and the like disorders ever alleviates them. There is pain and abdominal dragging and sensations of a most persistent character.

In many instances a kidney that moves unduly may be recognized by abdominal manipulation. A tumor can be felt and rolled about in various directions. The absence of this sign, however, cannot be accepted as indicating that no such abnormality exists. In a stout woman upon whom I operated for symptoms which pointed to a movable kidney and where, in the absence of relief by abdominal belts and dyspeptic medicine, I made an exploration, on removing the perirenal fat I could move the kidney in almost any direction by the tip of my index finger. I fixed the kidney with sutures and the patient completely recovered and after the lapse of seven years is in excellent health. Hence in the diagnosis of movable kidney we must to a certain extent be dependent upon symptoms and the exploratory proceedings which the continuation of these signs sometimes undoubtedly indicates. Where there are symptoms of a constant nature which threaten to injure the health of the patient, and in the absence of any relief from an abdominal belt or support, the question of operation will have to be entertained.

Nephrorrhaphy, or the fixation of a kidney by suture, is a proceeding which may be practised with very good result. It consists in exposing the kidney by an incision from the loin and then securing it by means of strong catgut sutures passed within the fibrous capsule and out through the edges of the parietal wound. It may be urged that this is not possible in the case of kidneys which are rendered movable by reason of a complete mesonephron, and that where there are grounds for the belief, from the obvious mobility of the organ, that this is the case a laparotomy should be proceeded with and the organ removed in this way. I cannot, however, indorse a practice of this kind until the simpler proceeding has first been tried and exploration effected from the loin. Though I have operated several times for a movable kidney and have, on more than one occasion, met with what appeared to be a fairly constituted mesonephron, I never experienced much difficulty in reaching the surface of the

kidney. Failing in a proceeding of this kind, and the pressing symptoms continuing after the healing of the lumbar incision, I should have no hesitation in resorting to a laparotomy and removing the organ entirely. Nephrectomy should, however, not be adopted without the most careful consideration, as the liability to kidney disease as well as its gravity, so far as the remaining organ is concerned, is, as might be expected, considerably increased.

Perinephritic and Nephritic Suppurations.

I will now pass on to notice the suppurative effects of inflammation as observed around and within the kidney requiring surgical attention. Situated as these organs are, the consequences of a lesion from without, as a blow on the loins, or the irritation proceeding from within, as by the presence of a renal stone or tubercle, may be to excite suppurative inflammation in the fat and cellular tissue in which they are more or less loosely embedded. This condition is known by the term of perinephritis.

When we consider how deeply the mischief is in the first instance situated, and the nature of the texture in which it is located, it is easy to appreciate the difficulty of making an early and correct diagnosis, and to understand how readily, before the superficial tissues are implicated, the products of inflammation may travel to and involve neighboring parts. When suppuration has occurred, as is usually the case, numerous instances are recorded showing how the pus, when left to its own direction, has found its way into the corresponding kidney or into the adjacent spaces of the thorax and abdomen or their respective viscera. Hence a severe blow over the loin, or the sudden movement of a calculus within the kidney, are conditions which are not to be looked upon too lightly, especially when either happens in persons who are to be regarded as cachectic, or in poor physical condition.

Though most frequently caused by direct violence applied over the loin, or by disorders of the urinary tract which render all parts of the apparatus susceptible to inflammation, perinephritis is sometimes produced by inflammatory extensions from such other parts as the liver, gall-bladder, spleen, cæcum, and vertebræ. It is in tissue like the subperitoneal that inflammatory burrowing may occur with considerable facility.

Perinephritis is characterized by the local and general symptoms of inflammation: there is usually some swelling in the loin as compared with the opposite one; tenderness on pressure may be discovered if sought for, and the actual occurrence of suppuration, or the

presence of pus around the kidney, leads to those variations in the temperature as shown by the thermometer, which the surgeon is not at all likely to disregard. Very little reliance can be placed on the discovery of fluctuation as an indication that pus is present, perhaps two or even three inches from the surface. Long before this is demonstrable to the touch the practical surgeon will have reached it by an exploratory incision in the loin under an anæsthetic, in the course of which many ounces of matter may escape. To wait until fluctuation can be made out is often to allow valuable time to elapse in which serious if not fatal mischief may be done. Mr. Morris refers to an inability to extend the thigh of the affected side as in his experience an early sign of mischief. The matter evacuated in abscesses of this kind is variable in character; in some it is thin and ichorous, in others laudable, while occasionally it is most offensive with a decidedly fæcal odor.

In the treatment of this affection, though sedative applications to the part in the way of fomentations and poultices of flax-seed often afford great relief in the early stage, the surgeon should not be tempted to unduly postpone the search for and evacuation of matter. When the part becomes tense and hard, and the swelling and uneasy sensations of the patient are not subsiding, the presence of pus should be ascertained either by means of the aspirator or by an exploratory incision in the loin. The opening, as a rule, should be sufficiently free to enable the abscess to empty itself easily without the use necessarily of a drainage-tube, though the latter need not be dispensed with. As the abscess contracts the drainage-tube may be gradually shortened, but this process should not be unduly hurried, otherwise a troublesome sinus may be the result. It is hardly necessary to remark that all antiseptic precautions are to be taken.

Nephritis, resulting in abscess of the kidney independent of general septic conditions, is most frequently caused by injuries, and irritants such as calculi impacted within the organ and suddenly subjected by the movements of the body to some change in position. The suppurations here referred to, though often formed by the fusion of two or more primary foci, are of a more extensive character than those which will be brought under notice in connection with what is known as surgical kidney. Nor are they to be confounded with those chronic forms of suppuration where the whole organ is converted into a sac of pus of which the capsule and its septa are the boundaries.

I am speaking of that kind of suppuration where an abscess forms within the confines of what is practically a normal organ. Hence these suppurations are not as a rule of considerable extent and are usually

limited, I will say, to half an ounce or so of matter. We may reasonably assume if the fluid can be evacuated, or can escape naturally, repair may be complete. I have seen kidneys containing foci of putty-like paste which I believe, though originally abscesses, were in the course of absoption. There can be no doubt that in some of these instances the matter finds its way into the pelvis of the kidney and escapes with the urine, recovery eventually taking place.

Local and general symptoms of inflammation in the neighborhood of the kidney would warrant the performance of a lumbar exploratory incision. In many cases an opening has resulted in the discovery of fluid beneath the capsule of the organ, and the evacuation of matter has been followed by recovery. Such a proceeding should always be undertaken when persisting symptoms point to some structural mischief of this kind. I have never known harm result from an exploration of this nature, even if the result has been of a negative character, but on several occasions autopsies have caused me to regret its omission.

Surgical Kidney.

Disseminated suppurative nephritis, or, as it is commonly called, surgical kidney, differs materially from the preceding. Here we have an illustration of the septic effects on this organ of disease originating in another part. This form of suppurative nephritis is frequently seen in connection with cystitis caused by the presence of tumor, stricture, or enlarged prostate. It is, in conjunction with the dilatation of the ureter and of the pelvis of the kidney, the outcome of obstructive disease lower down, and its presence seriously handicaps the efforts of the surgeon in removing what caused it.

From experiments made some years ago it seemed probable that if, for the purpose of remedying that painful condition known as extroversion of the bladder, it was found possible to connect the ureters with the intestines and to divert the flow of the urine in this way, the emanations proceeding from the latter canal would be sure to destroy life by inducing a condition of surgical kidney. That the ammoniacal exhalations from the bladder are capable of bringing this about there can, I think, be no doubt.

This is a form of kidney disorder which often proceeds to a fatal issue comparatively slowly. Though usually occurring later on in life, the process by which a normal kidney is converted into a surgical one—a very inappropriate designation by the way—may be well studied in, and deducted from, such instances as the one recorded in a previous section where a ruptured kidney was treated by Dr. Rawdon by nephrectomy. A cystitis from the descent of fœtid and de-

composing blood clots, in the first place, caused dilatation of the ureter and, secondly, the molecular suppuration and disintegration of the remaining organ. In its relation to obstructed urination and surgical operations both of urgency and of expediency, it is of chief interest to the practitioner and moment to the patient.

The developmental process of a septic or surgical kidney is manifested by symptoms of a general character which, though not urgent in themselves, are usually referred to as of a low typhoid nature. The urinary invalid, perhaps suffering from the difficulties and complications attendant upon a large prostate where the use of a catheter is necessary, becomes feverish, his tongue is dry and so usually is his skin, the breath is offensive, there is headache and emaciation, and sleep, however gained, is unrefreshing. The blood, in fact, is charged with products which the kidneys are failing to eliminate.

Then we have, following, variations in temperature of a febrile character and frequently rigors. These are sometimes directly associated with catheterism or the use of instruments, while in other instances they are not. These rigors are often repeated and it has been stated, but I do not know with what degree of truth, that each recurrence marks the development of a fresh focus of pus in the kidneys. Profuse sweating sometimes follows these manifestations, and thus the powers of the patient are gravely taxed. The appetite is capricious and thirst is usually complained of. These symptoms may spread themselves over many weeks.

The urine may vary in character; it is often purulent or ammoniacal. In the earlier stage, where the disorder is limited to a pyelitis, though there is pus in the urine, the latter generally presents a distinctly acid reaction. Both kidneys are usually involved, but instances of unilateral surgical kidney are by no means uncommon. Death generally occurs from exhaustion, though in some instances there is complete suppression of urine, and the end comes painlessly from uræmia. The prognosis is most unfavorable.

The *treatment* of this condition is for the most part preventive, and the knowledge of what is likely to occur furnishes a sufficient reason in itself for the early treatment of all forms, urethral and prostatic, of urinary obstruction. In evidence of this we have only to look at museum specimens, where illustrations will be found, without number, of what is likely to occur if strictures of any kind are disregarded.

When this condition has developed and operative measures, even of a comparatively trivial kind, have to be undertaken, as for instance the emptying of the atonic bladder with the catheter, the surgeon will do well, when not compelled by any great or sudden urgency, to take all precautions specially directed toward averting such septic re-

sults. It was in reference to what the late Sir Andrew Clarke referred to as catheter fever that the attention of the profession was first pointedly drawn to this particular aspect of the subject. Catheter fever, as a rule, implies the existence of a surgical kidney, though it may not have reached that stage pathologically so as to be at once apparent to the unaided eye. Antiseptic precautions, combined with the sterilization of the urine by the use of quinine, boracic acid, salol, and the like, have largely diminished the frequency of instances of this kind. Where the state of the bladder or of the urine requires it, the gentlest form of catheterism with antiseptic irrigation will often also be required for the purpose of preventing the kidneys being injuriously influenced by the presence of morbid excretions below them which furnish a ready medium for the cultivation of bacteria. As a rule, the moderate use of stimulants, as in all septic disorders, combined with nutritious and easily digested food, will be required.

In reporting a case of unilateral surgical kidney, occurring in a patient upon whom nephrectomy was practised, which was followed by complete recovery of the man, Dr. Weir [5] draws the following conclusions: "I would consider it hereafter justifiable, if the patient's general condition would warrant it, in a case of acute septic invasion of the kidneys to make on one or both sides an exploratory incision not only in the hope of relieving the acute interstitial invasion, but also perhaps of encountering a larger and well-defined focus of pus, which pathological condition cannot always, it is understood, be readily discriminated from the more dangerous lesion of the veritable surgical kidney. Should the symptoms point, as in the case narrated, to one kidney only, or should a double exploratory incision show the same result, a nephrectomy may with some hope now be resorted to."

I have already stated that, in inflammatory affections involving the kidney where progress is not in the direction of recovery so far as the local symptoms are concerned, a lumbar exploratory incision is to be commended. It has frequently led to the discovery of an abscess either within or outside the capsule of the kidney, while in that condition of tension which exists during the process attending the development of a surgical kidney good might reasonably be expected from the adoption of a well-recognized principle. A timely incision in Dr. Weir's case might possibly even have averted the necessity for a successful nephrectomy. It seems probable that the albuminuria which so frequently follows the nephritis observed in connection with scarlet fever is largely due, in the first instance, to the mechanical tension under which during this complication the urine is excreted. If we had the means of relieving this physical condition during the process

of a nephritis I do not think we should hear so much of albuminuria as a sequel of this eruptive fever. Nor do I consider it as unlikely that this principle of tension-relieving by partial division or puncture of a fibrous capsule will be found on cautious trial capable of further extension. I allude to some of those inflammatory changes in the secreting texture of the kidney which take place in connection with certain affections somewhat vaguely referred to under the name of chronic nephritis. I have met with more than one instance where an albuminuria of some standing disappeared after an unsuccessful exploration of a kidney for stone. How much of this was due to the direct relieving of one kidney by the removal of tension and to the restoration of the excretory balance thus effected, is a matter affording interesting speculation.

In a paper on nephritis Dr. Keyes[6] has drawn the following deductions in relation to the circumstances under which surgical kidney is produced: "(1) To use reasonable care in exploring a healthy bladder or passing any instrument into it; (2) To use greater care if there be traumatism from stone, tumor, stricture, especially if the powers of the individual be weakened by age or disease; (3) To exercise every known precaution in exploring and manipulating instrumentally cases of dilated bladder in a fibrotic stage with enlarged ureters and damaged kidneys." These no doubt represent varying degrees of susceptibility.

Renal fistulæ are of two kinds, namely, those opening externally as in the loin, and those communicating with internal viscera such as the intestines. They are usually caused by wounds involving the kidney, such as stab-wounds or gunshot injuries, as well as by incisions in the course of surgical procedures for the opening of abscesses and the removal of renal calculi. Less frequently they have followed upon suppurations within the pelvis and cortex of the kidney. In some instances they appear to have served the purpose of providing a spontaneous means of escape for calculi and, where the ureter has been permanently obstructed, of furnishing a vent for the urine. Though externally they are most frequently found in the loin, they have occasionally opened as low down as the groin. Their urinous character is at once obvious, though the discharge, especially where their origin is of a tuberculous nature, is usually more or less mixed with pus.

Where the sinuses have opened into internal organs some remarkable symptoms have been the result. Morris[7] refers to a well authenticated case where a woman after an attack of renal colic and retention of urine vomited coffee-colored gravel and passed small stones by the mouth, rectum, and urethra. This is stated to have been an

instance where a fistula connected the kidney with the stomach. Some supposed examples of internal lesions of this nature, however, have turned out to be impositions, and therefore the practitioner must be on his guard before accepting such a conclusion. Morris records a case where an autopsy showed a renal fistula communicating with the left end of the great curvature of the stomach. The same author refers to some instances of fistulæ opening into the intestines as well as the lung. The former condition will probably explain some of those instances where air is voided with the urine by the urethra.

The *treatment* of a renal fistula is entirely dependent upon the circumstances surrounding it. Those following a simple incision or wound uncomplicated with any serious structural disease of the organ usually close with treatment such as is appropriate to all sinuses resulting from the imperfect healing of a deep opening of this nature. The application of well-recognized surgical principles almost invariably suffices. Failures after a sufficient trial are suggestive that a more serious condition of the kidney than was expected may exist. An exploration and, if not more is found necessary, a curetting of the sinus may in a chronic case be required. Some cases of renal fistulæ fail to heal because the corresponding ureter is either partially or completely obstructed.

I have recently seen a case of this kind in which a renal abscess followed upon an injury to the loin, and for some years the patient has passed a considerable quantity of his urine through the sinus. He collects it by means of an apparatus which causes him but little inconvenience. That he has no prospect of getting rid of his inconvenience without extirpation of the kidney I have not the least doubt, as examination of his bladder by the electric cystoscope clearly shows that the ureter is obstructed. With this instrument the pumping action of one ureter can be plainly demonstrated, while in the other it is absent. As the patient's health is excellent and the urine is normal and the question of convenience is not advanced, I should not consider the extirpation of the involved kidney justifiable.

Cases of this nature—and there are not a few of them—seem to have an important bearing upon the treatment of the most serious forms of deformity of the bladder. Reference will be found to this aspect of the subject in my article on diseases of this organ. The importance of the electric cystoscope in enabling us to determine as to whether a patient has one or two working kidneys will now, I think, be generally acknowledged.

Passing to other instances of renal fistula illustrations will be met with where there can be no doubt, from evidence afforded partly by the local condition and partly by the state of the general health, that

the kidney with which they are connected is to all intents and purposes a foreign body. Like a joint or a limb it may have passed into a pathological condition which renders its retention eventually as a part of a healthy or a living body absolutely impossible. Under such circumstances nephrectomy after exploration must be proceeded with as in the analogous illustrations I have taken, where the removal of diseased parts becomes obvious. A similar course of action will be called for in those instances where the evidence is sufficient to show that a renal fistula is the cause of some progressive disease in an adjacent internal organ.

An exploratory operation or nephrotomy should, as a rule, be selected before adopting the more radical procedure, as, if found necessary, the latter may follow upon the former without adding to the difficulties or risks connected with it. It is under such circumstances that the great value of the lumbar method as against the abdominal becomes apparent. Many instances of fistula dependent upon calculi, suppurations, hydatids, and the like have been completely remedied by a sufficient incision for a digital exploration of the part. Unfortunately I cannot put my finger on the record, but I have a distinct recollection of reading a well-narrated case where a pin or needle covered with phosphates was successfully removed from a kidney through the loin and proved to be the cause of a fistula, hæmaturia, and purulent urine.

Hydronephrosis.

Hydronephrosis is a term applied to the dilatation which the pelvis and calyces of the kidney undergo by the pressure of the urine when the latter is prevented escaping in a natural manner into the bladder. It is as if a band were gradually drawn round the ureter while the excretion by the kidney continued. Hence the term indicates a variable state of distention and the implication of one or both organs in the process. When extreme it may result in the absorption by pressure of the entire excreting portion of the gland and the ultimate conversion of the kidney into a fibrous bag containing fluid, of which the capsule and the septa are the boundaries. When the process is limited to one kidney, the opposite organ often proves equal to meeting the requirements for the entire excretion of urine, but the condition obviously becomes extremely serious when both kidneys are implicated in the cause upon which the hydronephrosis primarily depends.

With such a definition before us it will not be very difficult to recognize the various circumstances under which one or both ureters may be subjected to a degree of pressure sufficient to bring about

such changes in the kidney. In the first place, we have evidence that hydronephrosis is sometimes the result of congenital defects in the ducts. Folds, twists, valves, and obliquities in the mode of entering the bladder, in the ureters have been found explanatory of this effect. In a case recorded by Sir William Roberts in his treatise on "Urinary and Renal Diseases," the pressure of an anomalous branch of a renal artery appeared sufficient to cause it. Various malformations in the course of the ureters and their relations with the kidneys have also been described as associated with hydronephrosis.

The accidental causes of ureteral obstruction are equally various. In an analysis of 142 cases of hydronephrosis Morris mentions numerous causes for interference with the descent of the urine into the bladder, of which cancer involving parts within the pelvis appears to be the most frequent. Cystitis, vesical calculus, villous growth of the bladder, enlarged prostate, hydatid and ovarian cysts are also enumerated. Out of these 142 cases which include various degrees of hydronephrosis 106 seem to have implicated, more or less, both kidneys. Dr. L. Landau* has drawn attention to some cases of intermitting hydronephrosis observed in women, which he connects with a twisting or "kinking" of the ureter belonging to the kidney involved. The symptoms in some degree resembled those of renal colic connected with stone, and were accompanied with tumefaction of a varying character in the region of the kidney. In two of the instances recorded the symptoms disappeared during pregnancy—a circumstance which was explained by the movable kidney being fixed in position by the gravid uterus. In one case relief was afforded by an abdominal bandage. It is in cases such as this that well-directed massage temporarily removes both swelling and pain. Then we have lesions and injuries to the ureters which chiefly affect one side only; of these I may mention stones impacted in the ducts and contractions, or strictures, resulting from injuries to these tubes.

In 1883 I was consulted by a gentleman from South America about an injury he had received in the right loin from a bullock on a cattle ranch. The injury was not attended with an external wound, but there was a severe contusion of the part; it was followed by hæmaturia, and more remotely by right hydronephrosis, for which aspiration had been repeatedly employed. The point raised was, if the ureter is merely strictured, and not completely ruptured, can anything be attempted to save the kidney from atrophy? As it seemed probable the ureter had been divided, and the corresponding kidney was rapidly being atrophied, I came to the conclusion that it was advisable that nothing should be done, and I have since heard the

patient has completely recovered his health, though there can be no doubt he has lost a kidney.

The following case, recorded by Mr. W. J. Collins in a paper on traumatic hydronephrosis,* is of much interest in connection with the diagnosis and treatment of these injuries:

CASE.—G. W., aged 5, was admitted into the London Temperance Hospital on November 5th, 1889, in a collapsed state, having been run over by a cart, the wheel passing over the abdomen and pelvis. There was fracture of the left lower ribs and of the right os innominatum near the eminentia ilio-pectinea. The collapse suggested visceral lesion; the catheter drew off only a drachm or two of sanious urine. However, injection of the bladder with two ounces of boracic-acid solution, and the subsequent recovery of the same quantity by bimanual expression, proved that this viscus was unruptured. For some days the urine was blood-stained, but he made a good recovery and was discharged on November 30th, passing about twenty-three ounces of urine per diem. A week later he was readmitted on account of a painless swelling discovered in the right loin, extending above to the hypochondrium, below to Poupart's ligament, and inward to the navel. The colon was easily felt in front of the tumor; there was fluctuation. On deep palpation in the right inguinal region a hard, sessile mass was felt at or near the pelvic brim, which was presumed to be callus at the site of the pelvic fracture. There was neither pain nor fever, and the general condition was good. The urine was normal, but was reduced to less than half a pint per diem, sometimes only six ounces. December 10th, 1889, the tumor was aspirated from the loin, withdrawing 18 ounces of pale amber-colored fluid, of specific gravity 1.003, faintly alkaline, containing a trace of albumin and one per cent of urea. The swelling rapidly returned, and on December 16th, 20th, and 30th was again aspirated, withdrawing 25, 29, and 30 ounces respectively. Since this date it was aspirated at increasing intervals down to May 21st, 1891, the patient coming for this purpose as re-accumulation occurred. There were sixteen aspirations in all. Since May, 1891, there has been no appreciable return of the swelling, and the boy is in excellent health.

The still more remote effects of these injuries relative to the formation of a stricture of the ureter and hydronephrosis are exemplified in the following record by Dr. Pye-Smith[19]:

CASE.—"The patient was 24 years of age. About two years previously to his coming into Guy's Hospital he had been kicked by a horse on the left side 'under the short ribs.' This was followed by hæmaturia. On his admission to the hospital there was a large tumor occupying the left half of the abdomen, the physical character of which pointed to its connection with the kidney. The tumor was tapped, and a large quantity of fluid removed. After death the left kidney was found to be in a condition of cystic degeneration. The ureter was dilated for an inch and a half, when it suddenly became

contracted, so as not to admit the smallest probe. A few lines nearer to the bladder it again assumed its normal size."

These instances are sufficient to illustrate most of the points connected with the causation of traumatic hydronephrosis.

In some cases a hydronephrosis appears to be intermittent; at one time the renal tumor is tense, while at another it is soft and compressible, indicating a variation in the amount of its fluid contents. There can be no better guide in the diagnosis of these conditions than the recognition of the fact that a sudden increase in the voluntary discharge of urine is immediately followed by a corresponding diminution in bulk of the swelling occupying the region of the loins. Dr. James reports a case [11] in which he considered that the contraction of the bladder due to frequent micturition was the origin of a hydronephrosis, and Morris shows that this explanation may be extended to other causes leading to a considerable straining, such as phimosis and prostatic enlargement.

In illustrating how the ureter is obstructed it might be inferred that hydronephrosis necessarily follows, but this is not invariably the case. In some instances of occlusion from rupture and injury to the ureter where there is risk of urine being extravasated into the subperitoneal tissues, I have concluded from examinations made by myself as well as by others that extensive renal thrombosis is frequently an immediate sequence of an injury of this kind. Thus urinary excretion is modified by the more or less vascular consolidation of the organ involved, and the most serious complication attending such injuries is averted. This I believe proves to be the first step in the process of renal atrophy, in contradistinction to dilatation, which subsequently follows. Mr. Poland and Dr. Moxon have both shown that the blood-vessels of a kidney which has been injured are sometimes found to be entirely infarcted. This point will again be referred to in connection with injuries to the ureters.

The fluid contained in hydronephrotic kidneys is usually urine of a very dilute character, containing traces of the natural constituents. It is nearly always more or less albuminous. Prout detected urea and uric acid in the contents of a double hydronephrosis from a stillborn infant. In an analysis made by Sir William Roberts the cyst contained 83 ounces of clear fluid of a pale lemon color and urinous smell, sp. gr. 1.002, very slightly acid, with the faintest trace of albumin and presenting under the microscope a few broken-down cells of large size. Occasionally the contents of the sac are of a colloid nature.

Hydronephrosis need not necessarily go on to the complete destruction of the organ. In the case of calculi, the obstruction may be

dislodged and the sac emptied without further accumulation. Again instances are recorded where a frequent emptying of the cyst artificially has eventually ended in the atrophy of the organ, its place being supplied by the growth of its fellow.

The symptoms of hydronephrosis are extremely variable and are much dependent upon the size which the sac or sacs have attained. In the majority of instances no abdominal encroachment can be made out. On the other hand, cases are occasionally met with where these sacs attain such dimensions as to simulate dropsies, and instances are recorded where operations have been undertaken under the belief that ovariotomy was indicated. In a case cited by Mr. Glass [12] where thirty gallons of light coffee-colored limpid fluid were withdrawn after death from a huge sac representing the right kidney, the circumference of the abdomen was found to be six feet four inches, and from the ensiform cartilage to the os pubis it measured four feet and half an inch. The left kidney and ureter were healthy.

Passing to the opposite extreme it will be found that instances are frequently met with where hydronephrotic kidneys are discovered after death which do not appear to have occasioned any physical signs or objective symptoms during life. Hence I shall proceed to consider those examples where there is some evidence of renal enlargement. When limited to one kidney the condition of the urine is not at all likely to furnish any clue, as the opposite one is quite able to maintain the natural characteristics of the excretion. Under such circumstances surgical interference in a case of renal enlargement presenting an indistinct sensation of fluctuation would hardly be warranted unless inconvenience or pain were occasioned by the dimensions of the growth. Then a lumbar aspiration would be indicated when the nature of the swelling might probably be with more accuracy determined. In some instances such a proceeding has been followed by a gradual disappearance of the swelling.

When there are similar reasons for believing that both kidneys are involved, should either or both reach such dimensions as have just been referred to, the aspirator may be employed in the same way. Under the latter circumstances, however, we are much more likely to meet with symptoms of uræmia superadded to the local distress, and rendering the prospects of the patient extremely bad. The efforts of the physician may here be directed toward eliminating products which the kidneys have little chance of doing. Much may doubtless be done both by medicine and by diet in this way.

A case illustrating several points in the pathology and treatment of hydronephrosis has recently come under my notice, and some reference may be made to it here. It was that of a middle-aged man,

long resident in Australia where the disease had probably been contracted, suffering from hydatids within the pelvis. The disease was of several years' standing on his arrival in this country, and formed a tumor of considerable size. It appeared to be situated in the space between the bladder and the rectum outside the peritoneal cavity. It formed a prominence in the left hypochondrium, the bladder being pushed over toward the opposite side. It was impossible, by reason of the angle given to the urethra, to pass a rigid instrument such as a catheter into the bladder, but a long, flexible bougie was readily introduced. On passing the finger into the rectum the prostate was totally obscured by what felt like a solid mass about as large as a fœtal head. In this way the pelvis may be said to have been completely blocked. During the last few weeks both defecation and urination had become well-nigh impossible in spite of all kinds of expedients. The pain on these occasions was most excruciating, to relieve which the patient of his own accord took large doses of morphine amounting frequently to over six grains a day.

Various opinions had been expressed in reference to the diagnosis, but I do not think a definite conclusion was arrived at until I accidentally discovered hooklets in the fæces. This gave the clue to the case. The other symptoms were due to the great pressure exercised within the pelvis. Both kidneys were hydronephrotic, the ureters largely dilated, and the intestines distended and impacted with fæces. By degrees this state of abdominal and pelvic infarction became complete, and it was difficult to know what was best to be done for the patient. A laparotomy appeared out of the question, and to open and drain the cyst by a direct incision through the abdominal wall did not in the matter of subsequent drainage commend itself to me.

Mr. Durham was good enough to see the case with me and Mr. Rand. After a very careful consideration from all points of view we came to the conclusion that it would be best to open the cyst from the perineum between the bladder and rectum, and thus to empty and drain the cavity. This was accordingly done, and I made my perineal incision just as if I was performing a lateral lithotomy but without opening the urethra. The position of the latter was indicated to me by a flexible bougie passed into the bladder. I then made my way between the prostate and the rectum until the cyst was reached. This was freely opened by incision, when a large mass of hydatids sufficient to overfill a quart vessel was evacuated, the process of extrusion being assisted by abdominal pressure and the use of a lithotomy scoop. There was very little hemorrhage. A large gum-elastic drainage-tube was introduced and secured.

A number of daughter cysts were subsequently passed and free

drainage and irrigations were maintained. The hydronephrotic condition gradually subsided, and in the course of a short time the distended abdominal viscera had gradually returned toward their normal dimensions. The patient was able to go home at the end of three weeks from the private hospital where the operation was performed. The perineal wound still continued to drain, and the only symptoms the patient had to overcome were those directly due to the morphine habit which by reason of his previous sufferings he had acquired. The distention of the abdomen, partly by the hydatids and partly by the enlargement proceeding from the intestines and the hydronephrotic ureters and kidneys, rendered the case a remarkable one.

In the treatment of hydronephrosis it must not be forgotten that in some this condition is due to the impaction of the ureter by a calculus or even by a plug of necrotic renal tissue. This would not be unlikely in a case where the local signs had been preceded by the history of renal colic, or by the escape of renal calculi by the urethra. Under such circumstances a trial should be made to facilitate the extrusion of the obstruction from the ureter, as by the use of manipulation and shampooing of the loin. Two instances at least of this nature are reported, one by Sir William Broadbent (referred to by Morris) and the other by Sir William Roberts, where the loin tumors subsided under such efforts.

It is remarkable how little it sometimes takes to induce a calculus to move downward, and where a ureter is more or less permanently dilated, as in the case of persons who frequently pass calculi, the explanation is obvious. Reference has been made by me to the fact [13] that the injection of water into the bladder so as to distend it has occasionally proved of assistance in favoring the release of a calculus down the ureter. This process has also been found of service in expediting the discharge of tuberculous *débris* from the kidney. It would probably also be useful in those exceptional cases, such as the one recorded by Dr. Rattray and Mr. Greig Smith,[14] where sloughs of renal tissue made their escape by the urethra. Again it is of advantage in suppurative pyelitis, by assisting the escape of matter downward. It has been noted that after its adoption high temperatures from the retention of pus have ceased. Here causes are enumerated sufficient to start or maintain a hydronephrosis.

Reference has already been made to the difficulty that exists in determining between a large hydronephrosis and an ovarian cyst. A somewhat similar difficulty may also occur in the case of ascites and hydatid cysts. A dilated kidney can generally be recognized by the colon being in front of the swelling, and by the absence of resonance in the lumbar region. Further, much direct information relative to

an ovarian cyst may be obtained by a vaginal examination. Ascites often coexists with advanced hydronephrosis, but the changes in the level of the fluid arising out of altered positions of the body usually enable us to recognize this dropsical condition. Hydatids may be suspected by the presence of a characteristic fremitus as well as by vesicles in the urine.

Taking the instance of a single hydronephrosis which continues to fill and cause pain or inconvenience, in spite of the repetition of aspiration, what further steps can be taken? The more radical measures of nephrotomy, or opening the kidney from the loin and draining until the sac either consolidates or is reduced to the condition of an innocuous sinus, or the still more complete measure of nephrectomy or removal of the kidney, have both been recommended and practised. I am in favor of the former and would prefer its adoption, unless the necessary exploration through the loin that this entails leads to the discovery of a kidney which is completely disorganized. In the latter case a prolonged suppuration would certainly overtax the strength and endurance of the patient, and nephrectomy is indicated. These two operations will be described later on.

Pyonephrosis.

Suppuration involving the pelvis of the kidney, however produced, may, by obstruction of the ureter incidental to such a condition, lead to the dilatation of the kidney and its conversion into a pus-containing sac. As with hydronephrosis, a bag of fluid bounded by the capsule and its septa may be thus substituted for the natural organ.

A hydronephrosis may become a pyonephrosis by the intercurrence of suppuration, and the causes of the former are among those of the latter. One or both kidneys may be involved in varying degrees, as we see in cases such as those of enlarged prostate with cystitis, and in the more advanced forms of urethral stricture. Of all the causes of pyonephrosis the presence of a calculus within the kidney is by far the most common, so much so that some have thought the term calculous pyelitis would be generally applicable. This, however, is not the case, as numerous examples of very extensive pyelitis and distention are the direct result of tubercular disease either in the kidney or its duct.

Instances occur where there can be no doubt the obstruction in the ureters and the pyelitis were directly due to the general invasion of the urinary organs with the gonorrhœal bacteria. These represent some of the most acute forms of the disorder, and death not unfrequently happens from uræmia.

The pent-up pus and urine in a pyonephrotic kidney will often escape intermittently along the ureter. Here the secretion in the first instance generally presents an acid reaction and is charged with pus which gradually falls to the bottom of the glass on standing for some time. When the matter cannot escape freely in this way, ulceration of the capsule may occur and the contents of the sac find their way in various directions, as through the loin, along the psoas muscle into the iliac fossa, under Poupart's ligament, or even into the cavity of the peritoneum. In some instances it has penetrated the diaphragm and escaped through the bronchi, while in others some part of the intestines has been opened into. Such are the numerous directions in which a vent may be found for an abscess of this nature when left to itself.

Ammoniacal decomposition of urine within the kidney may lead to the interior of this organ being largely encrusted by a soft, phosphatic, mortar-like substance which shows a tendency to adhere wherever the surface is rendered rough or uneven. Sir William Roberts states that fibrous septa within the kidney are sometimes calcified, and he refers to an instance where in examining a specimen of this kind it was necessary to cut the kidney across with a saw. Microscopical examination of a portion showed the characters of true bone, though in a rudimentary state.

The early symptoms of this affection are those of pyelitis. Reference has already been made to the surgical conditions under which it most frequently occurs. From this point of view we are chiefly interested, with the knowledge before us of what is likely to occur, in preventing obstructive disorders leading to such a state of disorganization. Urethral strictures and prostatic enlargement furnish examples of causes most likely to produce these effects unless dealt with in good time by suitable measures. In some instances of this kind renal tumefaction can be discovered, and when in conjunction with this we have rigors and variations in temperature the retention of pus is rendered probable. Some of these cases terminate in complete suppression of urine extending over three or four days before death occurs.

The most acute forms of suppurative pyelitis may be seen in connection with the cystitis arising out of urethral obstruction, and require prompt treatment by perineal cystotomy with drainage, as referred to in the section relating to cystitis.

Where the case is of a less acute character and there is such an amount of renal tumefaction as to render dilatation with pus and urine likely, an exploration should be made. This is best done in the first instance with the aspirator needle from the loin, the surgeon

being prepared, if evidence of pyonephrosis is afforded, to proceed to open the kidney for the purpose of digital exploration and drainage. In a certain proportion of cases where the disorder is not far advanced, though palpable enlargement of the organ has occurred, and the obstruction is removable either by the withdrawal of a calculus from the pelvis of the kidney or its spontaneous escape along the ureter, recovery after opening and drainage may occur. If, however, the kidney is completely disorganized, its removal should be proceeded with at once.

In selecting a nephrectomy or extirpation of the kidney under such states of disorganization, as, for example, in pyonephrosis complicated with a calculus, the surgeon will often find the operation one of considerable difficulty. The tissues by long-continuing inflammation are frequently indurated and matted together. Separation has to be effected with much caution. In some instances the cavity of the peritoneum has been opened by reason of the strong adhesions that have formed between the kidney and this membrane being perforated. Hence the operator, in determining to extirpate the kidney at once, should be fully aware of the obstacles he may encounter. On the other hand, most satisfactory results are sometimes obtained by avoiding the great tax on the patient's strength that is entailed by a long and useless suppuration, however perfect the contrivances for drainage may be. Then again, in selecting between nephrotomy and nephrectomy the possibility of the drainage resulting in a lumbar fistula maintained by the vitality of a small portion of renal gland tissue must not be overlooked. In a case of pyonephrosis which I opened and drained with a large amount of success and great comfort to the patient, I had eventually to open up the wound and scoop out what remained of renal tissue by reason of the great annoyance a small urinary fistula entailed. The operation, for reasons I have already referred to, was extremely difficult and tedious, but the result was in every way satisfactory. My only regret was that I did not do this at first, when I opened the kidney to relieve the pressing symptoms of purulent dilatation.

I have thought that some collections of matter in the kidney might with advantage be drained through an opening in the perineum, instead of being submitted to other procedures, such as incision from the loin, and even in some instances to nephrectomy. I was first impressed with this belief by observing the relief it was possible to afford to the ureters and kidneys, which were undergoing chronic suppuration as a consequence of tight stricture in the urethra. Cases of this kind, even complicated by ulceration of the urethra behind the obstruction and extravasation of urine, have frequently proved so

satisfactory to treat, that I felt the principles of treatment which guided us here might with equal advantage be extended to some forms of kidney suppuration. Nor have I been disappointed in those instances where I had reason to think that the last-mentioned condition was the cause of the purulent state of the bladder for which the operation of perineal urethrotomy was undertaken. In a paper on this subject [15] I have referred to ten cases of suppurating pyelitis and ureteritis treated with advantage by this method. Had only one organ been involved, I might perhaps have reached and drained it from the corresponding loin. In one case where I opened the perineum and drained an extensive suppuration, I found the cause of it was a psoas abscess from caries of the vertebræ which had burst into the kidney. Though large quantities of healthy pus were in this way discharged, the reaction of the urine remained acid throughout, and the patient was spared much pain in voiding this mixture of pus and urine. Dr. Cullingworth [16] has reported a case of renal abscess caused by a fragment of a carious vertebra ulcerating into the kidney and forming the nucleus of a calculus.

In the after-treatment of operations involving the kidneys care must be taken that the antiseptics used are not too strong. Most of us have seen that condition known as carboluria, where the urine is darkened by the absorption of carbolic acid. Mr. Edmund Owen [17] relates a case where nephro-lithotomy was followed by severe salivation after mercuric chloride had been used in the proportion of 1 in 1,000.

Renal Calculus.

The impaction or retention of stone or gravel in the kidney and its surgical treatment will now be considered. It will be necessary to offer some remarks as to the views that have been advanced and are entertained relative to the formation of these bodies, their varieties as well as the changes they undergo, and the different positions they occupy in the gland.

Though it is in the bladder that the larger proportion of calculi grow and attain that bulk which renders them at present unamenable to any other than surgical treatment, it is in the kidneys they for the most part take their origin and from whence the nuclei of these concretions are mainly derived. Apart from the fact that many stones are prevented leaving the kidneys, where they increase in size and reach considerable dimensions, to the great detriment of the tissue in which they are lodged, the former consideration is sufficient to call for some general observations.

Urinary calculi may be said to be formed (1) by the aggregation

and consolidation of certain constituents of the urine which it is the province of the kidneys to eliminate—of these I may instance uric acid, and oxalate of lime, and less frequently cystin, carbonate of lime, and some rarer substances; and (2) by the aggregation of inorganic particles precipitated from the urine as a product of its decomposition. The latter concretion consists of the phosphate of lime and the ammoniaco-magnesian phosphate. Hence relative to the urine all calculi may be said to be either of primary or of secondary origin.

It is not within the province of this article to discuss the physiological modes in which the constituent particles of the primary group take their commencement, but it may be assumed that in the process of their elimination they all pass through the kidney, where they are liable to concrete. So far as the secondary group is concerned it is sufficient to say they are capable of being produced wherever it is possible, within the limits of the apparatus, for the urine to stagnate and undergo ammoniacal decomposition. Though not necessary in the case of primary calculi, the presence of a nucleus, upon which the particles may in the first instance range themselves, is essential in the secondary. Hence the latter forms the material all bodies are coated with, which are foreign to the urinary apparatus, such as bougies, catheters, pins, needles, bootlaces, feathers, and calculi of the primary group, when they have remained sufficiently long in contact with the urine to set up the amount of inflammation necessary for the production of the ammoniacal decomposition of the fluid. Hence under such circumstances the secondary process of calculus formation may be observed, and, if required, artificially demonstrated.

Calculi may be divided into three groups: (1) pure specimens of primary formations, as uric acid, or oxalate stones; (2) specimens consisting of more than one variety of primary constituent, as, for instance, a calculus partly composed of uric acid and partly of oxalate of lime, and (3) mixed stones or alternating calculi, where the primary constituent, we will say of oxalate of lime, has assumed such dimensions or shape as to excite inflammation in the part in contact with it sufficient to produce ammoniacal decomposition of the urine; then the stone will become encased with a covering like plaster of Paris composed of a mixture of the phosphate of lime and the ammoniaco-magnesian phosphate. Practically all calculi may be thus grouped.

Formation.—It will now be necessary to consider the mode in which the minute organic particles or crystals of which these concretions mainly consist are in the first place drawn together and consolidated into masses of various density. To understand this clearly is the keystone to the prevention of these formations.

Considerable light has been thrown on the subject by the researches of Rainey, Ord, and Vandyke Carter.[18] These observations point to the probability of stone being formed in the urinary passages by the concurrence of conditions which, though not necessarily in themselves morbid, may be said to contribute toward the production of that which is hurtful. They may be briefly summarized as tending to show that some salts, in the presence of a colloid material such as gum or albumin, yield, not crystals, but certain bodies to which Carter has applied the term "submorphous," having the peculiarity of adhering not only to existing surfaces, but also to each other, in laminar series. In the urine may constantly be observed lithates presenting an appearance similar to these submorphous forms, and the presence of an organized material partaking of the nature of a colloid has been demonstrated as existing in a large proportion of urinary calculi. In reference to the production of a calculus by molecular coalescence, Dr. Vandyke Carter remarks: "Regarding first the probabilities of the case, it seems to me that the necessary conditions for the operation of molecular coalescence may at times occur in the living human subject; thus an excess of mucus, perhaps altered in character in the urinary passages, or the effusion of albumin, fibrin, or blood and the like, say from congestion of the kidneys or from irritation of the urinary tract, would furnish a colloid medium, with which uric acid, the urates or oxalates themselves, perhaps in excess, could combine in the manner before described." Added to this is a note from Rindfleisch (Vol. II., p. 143): "I have long been in favor of the view that the epithelial cells with which the straight tubes are lined generate a colloid material in their protoplasm, which they pour out in the interior of the tubes."

Carter further observes, relative to this process: "With regard to some *shell structures*, it will be sufficient to remark that compact and even incipient layers often bear such a close resemblance to the product of experiment that it is affirmed the intervention of cell-influence is not needed to account for their formation (Rainey and Harting); and some of these layers being very similar in character to those found in urinary calculi, the inference is again in favor of the latter originating in a manner essentially identical." Analogical evidence of this kind tends, therefore, to support the view of the non-vital origin of the submorphous structures named, notwithstanding their association with living organisms, or with matter once part of such.

That a formative act such as is here referred to is actually going on within the human urinary apparatus, is also rendered probable from the examination of stones immediately after they have been re-

moved entire, as by lithotomy. It will be found they are covered with a distinct layer of viscid mucus, which often adheres with such tenacity as to require washing, with friction, before it can be entirely removed. The conditions under which this process of stone formation by molecular coalescence proceeds seem not yet determined. That there is some affinitive attraction between the various kinds of inorganic particles engaged which may be regulated by those in excess, through the medium of the colloid, is not improbable, otherwise it would be difficult to understand how grouping takes place with such precision.

The view thus entertained as to the formation of calculi by molecular coalescence through the intervention of colloid has had weight incidentally given to it by some remarks of Mr. Cadge in his address before the British Medical Association, at the annual meeting at Norwich in 1874. Referring to matters connected with diet, he observes that "the prevalence of stone amongst the children of the poor is largely due to their not obtaining a proper and sufficient supply of sound milk," and that the abundance of stone in children "will be found in strict accordance with the difficulty of procuring milk." That is to say, in place of a fluid food which is generally regarded as unirritating to the urinary organs, others are substituted of an opposite nature, and thus the urinary mucus is considerably increased. I have had frequent opportunity for verifying this observation. Dr. Plowright[19] more directly supports the colloid view, but from a somewhat different standpoint. In reference to the use of salt as an article of diet, he observes: "(*a*) That the presence of salt greatly increases the solubility of uric acid; (*b*) that the consumption of salt by increasing thirst insures a larger amount of fluid passing through the urinary tract, and therefore lessens the probability of calculus; (*c*) that by keeping the colloids equally diffused, salt tends to prevent the crystalline solids of the urine from agglomerating into calculi." Dr. Plowright found from experiment that the addition of 2 per cent of salt quadrupled the solubility of uric acid.

It has long been noticed, as Prout remarked, that "hard waters have a great influence in producing stone." Mr. Cadge also observes that "the balance of evidence was in favor of stone cases being connected with hard drinking-water." In various neighborhoods, I am told, the change from a hard to a soft drinking-water by the substitution of an artificial supply has resulted in a considerable diminution of stone cases. From some observations I have noticed that corresponding variations in the quality and quantity of urinary mucus follow the drinking of waters of different degrees of hardness.

It would therefore appear probable that the intercurrence of provision for the supply of a suitable colloid in the urinary passages

may be sufficient in itself to favor the formation of gravel and stone without any necessary alteration in the amount of the urinary solids.

For, assuming that eight or ten grains of so insoluble a deposit as lithic acid is daily excreted,[20] it seems to me that there is not an individual in fair health who is incapable of forming a stone in a reasonable time, provided that the circumstances for concretion are favorable. If, for instance, a man in the habit of excreting ten grains of lithic acid a day was only to void half this with his urine, and concrete the remainder, it is obvious he might form a stone of this material alone, weighing not less than half an ounce, in something like forty-eight days. In a woman the probabilities of her forming a stone are very considerably less, not because she necessarily excretes less lithic acid, but by her different mechanism for urination, not to say anything of the absence of a muscular ring or buttress at the neck of the bladder like the prostate. In her case the earlier nuclei of stone are tolerably sure to make their escape from the bladder, as it is only when a calculus too large to pass through the urethra descends from the kidney, that the possibility of an increase, in this position, is at all likely to occur. The rate at which triple phosphates will concrete in both sexes, owing mainly to the rapidity with which they are capable of being produced, is sometimes very remarkable. Though lithic acid may be the predominating calculus of the Eastern counties in England, I do not see it asserted that the urine of the inhabitants contains it in excess as compared with those residing in other districts. In the expression, "it may be that the abundance of stone in Norfolk is due not to actual excess, but to circumstances which merely determine the precipitation and separation of lithic acid in the urinary tract," Mr. Cadge[21] almost offers the explanation I am venturing to lay some stress upon.

On ground such as I have referred to, I believe there is much practical value in the views based on the colloid theory relative to the formation of stone. It certainly offers a reasonable and demonstrable explanation, founded on what appears to be a precisely analogous process, of the fact that stones are usually formed in the human body not by the aggregation of salts the elements of which are foreign to the system, but by that of those which it is the natural province of the kidneys to excrete in not necessarily excessive quantities.

The other process of concretion differs from the foregoing, as it is dependent upon inflammation, it being requisite for the formation of a triple-phosphate stone that the inorganic element composing it should first be precipitated by the decomposition or a rearrangement of the urine. When this has been accomplished, then the coalescence

of the gritty particles may be brought about as in the preceding manner.

It is probable that under such circumstances as these, the crystalline nuclei of calculi are collected and deposited within the kidney and increase in size within the area of the cortex, or in the more distinctly tubular portion of the organ. Hence we have cortical or some fixed stones in contradistinction to these lying comparatively loosely in the renal pelvis.

The terms "gravel" and "stone" are generally used to indicate the concretions formed within the urinary apparatus. The former is applied to the smaller varieties, while the latter denote those stony masses which as a rule require some surgical procedure for their removal. There is, however, no arbitrary limit between the one and the other. A retained gravel is, sooner or later, likely to attain the dimensions of a stone.

These concretions are met with at all periods of life, and they have even been discovered within the kidneys of new-born children. I once saw a female infant, only a few months old, in whom a sharp hæmaturia was due to the passage of uric acid crystals of sufficient size to be palpable to the touch. Under a diet composed of Contrexeville water, milk, and barley water in equal proportions the symptoms and the gravel entirely disappeared.

Physical Characters.—Kidney stones vary much in size, shape, and numbers. Some stones are round like peas and are often present within the kidneys in considerable numbers, though their form enables them to escape along the ureters into the bladder with tolerable ease. Other stones are built up evidently by an aggregation of crystals. These, as for instance in the case of oxalate of lime, though they may not be much larger than those just referred to, are exceedingly irregular in outline and are liable to scratch and pain the parts over which they are passed or along which, as in the case of the ureters, they are extruded. Some renal stones are of considerable size, weighing many ounces, and are branched in the form of the interior of the kidney. Such specimens, by their growth and pressure, apart from the inflammation they are liable to excite, eventually bring about the disorganization and destruction of the organ in which they are situated. A stone in the kidney is to all intents and purposes a foreign body, and must be looked upon as such.

One or both kidneys may be the habitat of a calculus, and when, as sometimes is the case, both ureters become in this way occluded, the condition of the patient may be looked upon as imminently fatal unless the cause of the obstruction can be removed either without or with a surgical operation. These instances will again be referred to.

The *symptoms* indicating the presence of stone in the kidney are various; they are seldom all present in the history of any given case, and they are liable to be modified, or to remain in abeyance, by circumstances which are determined by the position the calculus occupies in the gland or its outlet. The most common symptom is that of pain, which may be either direct or reflected. By direct pain is meant that which is more or less constantly complained of in the region of the kidney. It is, as a rule, aggravated by movement of the body. In many cases, though there is some degree of pain or uneasiness when the patient is at rest, it becomes intense on his engaging in work which necessitates movements of the body. On this ground alone I have operated on several occasions with success though all other symptoms of renal calculus were absent. In the case of a cortical stone this, in fact, may be the only symptom. The pain is usually increased by pressure over the kidney or when the loin is grasped with the hand. Then there is the violent paroxysmal pain know as kidney colic, when a stone is on the move and is making its way down the ureter toward and into the bladder. Probably this represents the most unbearable form of suffering, and as a rule calls for the use of an anodyne. These paroxysms are often accompanied by rigors, vomiting, cramp, and profuse perspiration. There is usually a frequent desire to pass water. Then we have the reflected pains; of these, the most common are those down the groin and in the testicle, the gluteal region, and along the inner side of the thigh and leg. The former are often accompanied with more or less retraction or drawing up of the testicle. The paroxysm of intense pain often terminates abruptly, and the patient is at the same time not unfrequently conscious that something has suddenly dropped from the ureter into the bladder. Later on he may also be aware that the calculus has escaped from the bladder, being voided in the act of micturition.

I have met with several instances of individuals with some personal experience of this disorder who have felt quite sure that the stone had not left the bladder, being too large to escape by the urethra. This has led to the introduction of a lithotrite without waiting for the stone to increase in this position, and the immediate crushing of the calculus and its evacuation. Thus a slight and safe operation is substituted for one when by the size of the stone the difficulty and risk are proportionately increased. Because a patient is not conscious of spontaneously voiding stone during micturition and obtaining evidence of it, this by no means implies that he has not done so. Most stones of recent descent from the kidneys are, I believe, usually voided during defæcation, when the expulsive acts are as a rule most advantageously performed.

Hæmaturia, or the passing of blood with the urine, is a frequent sign of calculus in the kidney, as it is also when the stone is in the bladder. In the former case it is variable in amount and is due to the scratching of the soft parts by the movement of the calculus. I have known it profuse in a case where a calculus was accidentally dislodged from its position within the kidney by a severe fall. Some days after this occurred I cut down on the kidney and removed from the cortex an oxalate stone which, though not large, was much spiked; the hemorrhage ceased in the course of a few days and the patient made a good recovery. Of course, where there is blood, albumin in a corresponding proportion will be found in the urine. Instances are, however, met with where the irritation of a stone causes albuminuria independently of hemorrhage, as I have known it to entirely disappear after the removal or spontaneous escape of the foreign body. It must not be forgotten that in recurring attacks of renal colic the symptoms may be much modified by reason of the comparative ease with which calculi move along parts dilated by previous attacks of this kind.

The presence of pus in the urine is frequently seen in connection with a renal calculus, and when taken together with other symptoms is evidence that inflammatory changes are in existence which may terminate in the disorganization of the organ. It is a symptom, in conjunction with attacks of renal colic, of grave importance.

In the early stages connected with the impaction or rather retention of gravel within the kidneys, a very considerable increase in the amount of mucus in the urine may be observed. It is not uncommon to find in cases of this kind, on placing the excretion in a urine glass and letting it stand for some time, that though blood and pus may be absent the amount of mucus is often doubled or even trebled, while its density is increased. This is a symptom of considerable importance, especially in young persons who are not likely to have any prostatic enlargement. Sufficient stress is not always placed upon this point.

As Sir William Roberts has pointed out, renal stones may sometimes be latent and quiescent so far as all symptoms are concerned. This author remarks: "Renal symptoms may exist for a longer or shorter period, and then wholly and finally cease. This latter event may occur under two circumstances; either the concretion completely occludes the ureter, and determines gradual atrophy of the kidney, or it becomes encysted in a lateral pouch or diverticulum and ceases to impede the flow of urine and to irritate the mucous membrane."

The *diagnosis* of renal calculi is not usually attended with much difficulty, though in the case of cortical stones, as already remarked,

the symptoms are not always well pronounced. As with the bladder, stationary stones do not so readily declare themselves as those that alter their position somewhat in accordance with the movements of the body. The diagnosis of renal calculus has in some instances been aided by the surgeon recognizing from the loin on manipulation a characteristic grating when more than one calculus was present.

Suppression of urine is occasionally met with as a consequence of the presence of calculus affecting both kidneys, or when only one kidney exists. There is a case recorded by Dr. D. Newman where death followed suppression of urine which had existed for five days. At an autopsy, symmetrical blocking of both ureters with calculi was found. Mr. Godlee records a case where large calculi were removed from both kidneys in successive operations, and Mr. Lucas cites an instance where nephro-lithotomy (following nephrectomy) for total suppression of urine was permanently successful.

The conditions which may in some degree resemble renal calculus are the periodical discharge of large quantities of crystalline material down the urinary apparatus as we see in certain gouty subjects, as well as the subacute symptoms which sometimes arise in connection with the passage of organized substances from the kidney downward, as occurs in cases of tubercular and cystic kidney and in hydatids of this organ. A storm of uric acid crystals, for instance, in their transit downward from the kidney may cause symptoms closely resembling those of renal colic. There is local pain and spasm, aching down the thighs or sensations in the testicles, not much less severe than when a stone in passing, and occasionally the urine is tinged with blood. It is a form of gout which generally ends in this way when the symptoms gradually subside. Oxalate of lime crystals in some dyspeptic subjects may produce similar effects. The microscope serves to provide the means of making the diagnosis in these instances.

The *débris* caused by the disintegration of tubercular abscesses and its escape down the ureters will sometimes provoke much renal colic, in the same way that the colloid contents of cysts opening into the kidneys will do. These conditions, however, are not very likely to be mistaken for those of renal calculus, though they may be the cause of very considerable intermittent pain.

I have recently seen a case in which a woman for a long period was supposed to suffer periodically from the colic of kidney stone, and the attack certainly had a close resemblance to the latter, judging from the description that was given. This conclusion was somewhat strengthened by the fact that I had removed a uric acid calculus from the bladder of her father by crushing. However, when the urine came

to be examined the presence of hydatids was readily discovered in the excretion, which observation was corroborated by a physical examination of the loin. Hence in all instances where there is pain such as we get with the movement of calculi in the kidney, the urine should be carefully tested, and examined with the microscope, before a conclusion is arrived at.

The *treatment* of renal calculus may be considered under the three headings which the subject naturally presents: (1) Preventive; (2) Medicinal; and (3) Surgical. It is the last section that more strictly comes within the limits of this article.

It may, however, be said before proceeding to an operation for the removal of stone from a kidney the surgeon will probably satisfy himself that such expedients as massage and the shampooing of the affected side in conjunction with the flushing of the urinary apparatus from within, as, for instance, by the drinking freely of bland fluids such as pure water or barley water, or of medicinal waters as those of Contrexeville, Ems, and other spas that might be mentioned, are of no avail. If in spite of these attentions the symptoms of renal calculus remain unrelieved, the protracted as well as the prospective suffering of the patient will demand the mechanical removal of the foreign body before the time has arrived when structural deterioration of the organ commences.

It will be convenient to describe in this section the two operations which a calculus within the kidney may entail. These are nephro-lithotomy, or the removal of a stone from within the limits of the kidney, and nephrectomy, or the extirpation of the organ when, by reason of the continued presence of a stone, the kidney has been so destroyed as to be not only beyond the reach of repair, but as harmful to the body generally as a disintegrated joint urgently requiring removal or amputation of the limb.

As it is not always possible to be absolutely certain of the existence of a calculus within the kidney, especially in those cases where for some reason or other, as for instance the fixation of a stone, the leading symptoms are in abeyance, the operation of nephro-lithotomy becomes dependent upon what exploration of the part with the finger reveals. Digital exploration of the suspected organ is a method free from risk and a necessary preliminary to, as well as part of, what will have to be done if a stone is discovered. It will be understood that my remarks now are entirely confined to the lumbar proceedings. To expose a kidney with the view of exploring it both by sight and touch, or for the purposes of nephrotomy, nephro-lithotomy, or nephrectomy, an opening in the loin is required. Such an incision is to be selected as is capable of adaptation for the several procedures

mentioned, should exploration prove the necessity for adopting further measures.

A vertical or a transverse incision is usually selected, or a combination of the two. The vertical incision may be made along the outer border of the erector spinæ from the lowest rib to the crest of the ilium. If the transverse opening is preferred a line should be taken, to the extent of about three or four inches, corresponding in location with that for a lumbar colotomy, though somewhat closer to the rib than in the latter case. The vertical incision as described, with a transverse extension forward to the length of about three inches, will in most subjects be found convenient as giving the greatest amount of room for manipulation in every direction.

The subsequent stages consist in the division of the layers of muscle and fascia until the perirenal fat is exposed, which is readily distinguishable. There is seldom much bleeding, and the steps of the operation will be greatly facilitated by the use of suitable retractors. As the kidney is approached, firm pressure from the front, by the hand of an assistant, assists the operator in recognizing it with the finger. The surface of the kidney should then be carefully explored by the finger both in front and behind as far as it is possible to do so without unnecessarily loosening its connections. In this way the operator will soon learn to recognize inequalities in surface and textural differences which indicate stone, fluid, new growth, or an undue mobility of the organ. If the finger is not sufficient for this purpose the kidney may be punctured in one or more places with a fine trocar, and thus the presence of stone, for instance, or fluid, as in the case of a cyst or a suppuration which otherwise might escape notice, may be ascertained. The information so obtained, either negative or positive, will determine what is best to be done.

In this way nephrotomy or the free opening of the kidney may be practised, for the introduction of a drainage-tube in suppurative conditions involving the interior of the organ as previously mentioned. Where the kidney is opened along its free border for drainage as is usually the case, the sides of the wound may be anchored by silk or catgut sutures to corresponding positions in the superficial incision, so that there may be no obstacle to the escape of matter, though the mere insertion of the end of the drainage-tube within the kidney opening generally suffices. Any hemorrhage may be arrested by packing antiseptic gauze round the tube.

Assuming, for instance, that these methods of exploration fail in determining the presence of a stone, it is not to be concluded that no good will come out of the proceeding. In several cases where I have explored for pain no stone was found, but complete recovery fol-

lowed. I am disposed to think in some instances tension has been relieved and pain permanently alleviated by the opening of the capsule of the kidney for the purposes of puncture or further exploration, as sometimes happens in the case of the testes when inflamed. I have never seen any harm arise from direct lumbar examination of the kidney, and I can hardly recall an instance where permanent benefit did not follow. Some of these cases of recovery were explainable by a more absolute fixation of the organ following upon the procedure. Where the kidney has not been opened or is only punctured the wound in the skin may, if desired, be immediately closed by sutures.

I will now take the case where either by the finger or the exploring trocar direct and unmistakable evidence is afforded of the presence of a stone. Our course of action will be influenced to a large extent by the position the calculus occupies in the kidney, and its size.

The last two cases of renal calculus I operated upon presented varieties which will conveniently serve to illustrate this point. The first case was that of a man who for many years had a fixed pain in his kidney without, I may say, any other symptom. I hardly expected to find a stone, yet on reaching the kidney my finger felt one about the size of a filbert situated in that part of the cortex which naturally would first come within my reach. With a few scratches of my nail I was able to expose the calculus and then to remove it with a pair of forceps. A drainage-tube was introduced and the wound was closed around it with superficial sutures. Recovery was complete in ten days. In the second case the symptoms of renal calculus were much more pronounced, the patient frequently suffering from acute attacks of lumbar colic but with no hæmaturia. In a similar way I explored the kidney, and in front of the organ, just at the junction of the pelvis and hardly within reach of my finger, I felt a stone, but without drawing the kidney out of the wound for the purpose of examination, a step which I do not prefer, it was impossible for me to expose the foreign body in this position. Even if I had been able I should not have removed it in this way, as by scratching through the anterior surface of the organ so near to the pelvis I should have left an opening which would certainly have resulted in a renal fistula. Under these circumstances I entered the organ by an incision along the convexity, which was easily within reach, and passed my finger into the dilated calyces from which two stones were speedily removed by forceps. A drainage-tube was introduced down to the surface of the opening in the kidney, and then the superficial incision was drawn together by sutures around it. The patient rapidly recovered without, as far as I could ascertain, any urine escaping except by the urethra.

By thus reaching the stone, after its position had first been defined by examination of the surface of the organ with the finger, its removal was rapidly effected without any unnecessary laceration, and by means of such an opening for the withdrawal of the calculus as would not be likely to fail in healing rapidly and completely. These two different proceedings thus illustrated represent, I believe, important principles in the operative treatment of renal calculus.

Where exploration shows that the stone is very large and branched, as is often the case, it is desirable to extend somewhat, by means of a probe-pointed bistoury, the incisions referred to. In some instances it has, I believe, been found necessary to divide the lowest rib where the lumbar space is preternaturally small. This, however, is not to be recommended if it is possible to avoid it, as it adds considerably to the risk of the operation and endangers the pleura. It is occasionally necessary to break up a stone with a pair of forceps before attempting its removal. This may be the case in some of those stones which appear to be moulded within the expanded calyces. When there is evidence from exploration that the kidney has been so destroyed by the presence of the foreign body as to be beyond reasonable chance of speedy repair, it is best to proceed at once with the extirpation of the organ. To leave the mere remnants of a suppurating gland with its fibrous investment more or less thickened by a long process of inflammation, is sure to result in the formation of a troublesome sinus and the prospect of another operation.

Nephrectomy, or the complete removal of a kidney, is an operation which may be required for various conditions already incidentally referred to. Though, as a rule, we are provided with two kidneys, it should not be forgotten that examples occasionally occur where this is not the case and where the necessary amount of gland tissue requisite for the excretion of the urine is consolidated in one mass, somewhat variously disposed so far as shape is concerned. Instances are recorded, but very rarely, where the operator has discovered, when too late, that the kidney removed, though hopelessly diseased, was the only one. It is, therefore, of the first importance before proceeding to remove a kidney for the surgeon to satisfy himself by all available means that the opposite organ not only is in existence, but is in sufficient health to be able to provide for the entire urinary excretion; that, in fact, it is capable of undergoing those hypertrophic changes requisite for the attainment of this end.

Assuming in a given case that there is evidence that one kidney is seriously crippled by one or other of the various conditions already referred to, the surgeon will not neglect by frequent examinations of the urine to ascertain that in regard to both its quantity and quality

a fair standard is maintained. The amount of urea voided should be carefully estimated. The result of such an examination of the urine might lead, if the symptoms were not pressing, to some temporary postponement of the operation of nephrectomy, with the view of giving the sound organ a little more time for adaptation. With the same object the practitioner will not neglect, in prospect of extirpating a kidney, to ascertain by an inspection of the interior of the bladder with the electric light, or perhaps even by more direct means in a very doubtful case, whether both ureters are in action. The cystoscope is often a most valuable and practical means of diagnosis under these circumstances, which I consider should never be neglected in cases of this kind. Not only in this way can the pumping action of, and flow from, the ureters be, as a rule, seen, but the different character of the two urines discharging from these ducts, as for instance when one is purulent or tinged with blood, as compared with the normal flow from the opposite one, may be recognized.

The operation of catheterizing the ureters in the female is thus referred to in a case published by Mr. H. E. Clark:[22] "To settle our doubts as to the soundness of the right kidney we again catheterized the ureters. This was done by Dr. Macintyre and myself by means of Pawlik's catheter. The operation is in the female a very simple one, two ridges felt on the anterior wall of the vagina serving as useful and reliable guides, which lead the catheter directly to the ureteral orifices. The small quantity of urine removed from the right ureter was in every respect normal; that from the left contained pus, epithelial *débris*, and a trace of albumin."

It has been urged in favor of abdominal nephrectomy that the operator is not likely to be exposed to the risk of removing a solitary kidney by reason of his being able to ascertain beyond all doubt that this is not the case.

The lumbar operation consists in exposing the kidney by incision through the loin as already described. Sufficient room should be provided for manipulating the part to be removed by the extension of the transverse portion of the opening to about four inches in length. The surface of the organ having been recognized the operator should proceed to free it, mainly with the index finger, from surrounding connections. Care will be required in detaching it in front not to exercise too great force for fear of opening the peritoneal cavity. When the kidney has thus been isolated with the exception of its pelvic attachments, it should be gradually drawn through the wound, when the parts constituting the pedicle may sometimes be more clearly defined by the use of a blunt dissector. The pedicle is best secured by passing an aneurism needle armed with a long, stout silk

ligature between the ureter and vessels. If, as the needle is withdrawn, the ligature is divided in the middle, a noose will be provided for each of the two portions now forming the pedicle. As they are tightened the ligatures should be pressed well backward so as to give sufficient room for the removal of the kidney by division of the pedicle with the scissors. Morris mentions that the process of drawing out the kidney may be much facilitated by pulling the lower ribs upward with the fingers of the left hand passed into the incision. The ligatures should be cut off short and the pedicle dropped into the wound; when there is difficulty in restraining hemorrhage by ligatures, the bleeding points may be secured by pressure-forceps, which can be left in the wound where they will temporarily serve the purpose of drainage-tubes. In case this is not necessary a good-sized rubber tube should be passed to the bottom of the wound, when the superficial incision may be adjusted with sutures. If in the course of the operation the peritoneum is opened, the rent should be carefully closed with catgut sutures. The position of the patient in the after-treatment is entremely favorable for repair, and it is remarkable with what rapidity these wounds frequently heal.

Abdominal nephrectomy has been practised with success, but the lumbar method is the more generally accepted operation. The former is now probably limited to some exceptional cases of floating kidney, where there are grounds for believing from the movements of the organ that there is a very complete mesonephron, and to some instances of renal tumor. The method of proceeding usually adopted is that of Langenbuch,[23] where the abdomen is opened along the outer border of the rectus corresponding with the kidney which is probably involved. This plan is adopted by Mr. Knowsley Thornton,[24] who certainly favors the selection of this route. After the opposite kidney and ureter have been examined by passing the hand into the peritoneal cavity, a flat sterilized sponge is introduced to protect the intestines. The kidney is reached by opening the outer layer of the mesocolon, and is then enucleated. The vessels are tied either separately or in a mass, and the ureter is dealt with independently. Mr. Thornton thus describes his method of dealing with the latter: "Its renal end should be secured by pressure-forceps, then a ligature tied a little way from the forceps, and a sponge placed under it before it is divided. Whenever it is possible, I enucleate it for some distance from the kidney before dividing it, so that its cut end, with the sponge under it, may be at once drawn outside the abdomen; and I afterward fix it in the lower angle, or most convenient part of the abdominal incision, with a cleansed safety-pin. I regard this fixing out of the stump of the ureter as the most important detail in the

operation, and in every case in which I have been obliged to cut it off deep in the wound, I have had distinct evidence of suppuration and trouble round it." All vessels having been secured and the wound thoroughly cleansed, a Keith's glass drainage-tube may be introduced if there is any doubt as to the asepticity of the operation. Thornton does not consider there is any necessity to suture the edges of the sac from which the kidney has been withdrawn. The abdominal wound is finally closed in the usual way as after ovariotomy. Mr. Thornton also describes a method of removing renal calculi by combining the abdominal and lumbar incisions, exploring the kidneys by the former and then extracting the stone by the latter. The after-treatment of cases of nephrectomy, whichever route is selected, will be conducted with due regard to antiseptic principles, care being taken to secure the most perfect drainage of the wound. The use of opium is not to be recommended, as instances are recorded where there could be no doubt that even small doses interfered with the excretory action of the remaining organ.

I have endeavored to indicate in somewhat broad terms the conditions which would seem to determine the selection of the lumbar or the abdominal method. In a doubtful case I have no hesitation in stating that I would prefer the former mainly on the grounds that it is the safer operation. Its technique is, as a rule, not difficult, and the fact that the operator is behind the peritoneum and not within its cavity, as it is called, is a point which in the septic varieties of the conditions demanding the removal of the kidney is of no little importance. Then again, as already stated, when the operation is successfully over, no form of wound heals more kindly than these, for the reason that they are so easily drained. Only a few years ago, and not without reason, considerable stress was laid on the fact that by the abdominal method such a calamity in surgery as the removing of a patient's solitary kidney could not possibly occur. The force of this objection has been met by the character of the information that is now indisputably obtained by electric endoscopy. This instrument is no longer a chimera, and its use will relieve the surgeon of all apprehension when proceeding to perform a nephrectomy that the organ he is about to remove, though seriously and permanently crippled, should, by reason of the absence of its fellow, be regarded somewhat in the light of an unreliable pensioner whose services he is forced to retain.

Renal Tuberculosis.

Some observations will now be offered in reference to the surgical aspect of tubercular or scrofulous kidney in addition to what is in-

cluded under the sections devoted to nephritic suppurations and pyonephrosis. The deposition of tubercles in the kidney, its pelvis, or its ureter is a frequent cause of the latter conditions, and cannot as a rule be dissociated from them. Hence some general remarks on the subject of urinary tuberculosis will be necessary.

Tubercular disease of the genito-urinary organs has much in common with what is observed when it attacks other parts of the body. In the first place it is distinctly hereditary, and we usually find that a patient's predecessors suffered from some form of tubercular disease. The family history, therefore, is an important investigation, and should be carefully gone into when there are grounds for believing that the disorder may be of this nature.

Secondly, the disease corresponds in its occurrence with that period of life when the development and use of the sexual organs are commencing and continuing to be active; it is essentially a disease of adolescence and of vigorous though not necessarily robust manhood. It is comparatively rare in women. When tubercle attacks females the most frequent seat is the lungs, and why their sexual apparatus enjoys this comparative immunity is not at first sight so apparent. It may be, and certainly is to some extent, due to the fact that females are less exposed than males to what I may term the excitants, or perhaps more correctly the localizers, of this disorder. In tubercular subjects, protracted gonorrhœa and its complications, more frequently than all other causes put together, determine the deposit in some region of the urinary tract, from which it slowly spreads to other parts of the system. A chronic orchitis is a constant precursor of urinary phthisis. Women, though they suffer from gonorrhœa, do not do so in the same way or to the same degree, nor are their complications of the disorder so protracted or severe. Further, they are more readily cured. Tubercle may invade the urinary organs either from the kidneys downward, or from the testes upward; these are the more usual modes of accession. In the female, a labial abscess is often the initial lesion, as an inflammatory deposit in the testis may be in the male.

It will not be necessary for clinical purposes to occupy much time with a description of the mode in which tubercle invades the normal tissues, its varieties, or its chemistry; this part of the subject will be treated of at length in one of the later volumes of this series. In the form of gray miliary granulations, or as yellow caseous masses of various sizes, tubercle may be met with indiscriminately in any part of the genito-urinary apparatus; it is found in the kidney, the ureter, the bladder, the prostate, the vesicula seminalis, the testis, the epididymis, and the urethra; wherever implanted there is no knowing

where it will spread to. It will be seen that the tendency to diffusion is an important feature in relation to points connected with diagnosis and treatment.

Urinary tuberculosis, when the deposit is in relation with the mucous tract from the kidney downward, is almost sure to be associated with one or other of three symptoms, though as a rule they are all present in varying degree. These prominent symptoms are hæmaturia, frequent micturition, and excess of or change in the urinary mucus.

Hæmaturia stands in relation to this phase of the disorder as hæmoptysis does to pulmonary phthisis; it is frequently an early symptom, though the amount of blood lost in this way is generally small. The profuse bleeding of urinary tuberculosis is usually associated with its later stages of ulceration. I have seen a considerable amount of blood lost from those excavating ulcers of the bladder which are common in the course of this disorder. Then there is frequency of micturition, which as a rule, when the kidneys only are involved, is not explainable by anything that the surgeon can detect; and lastly there is a considerable excess in the urinary mucus. These are symptoms which, when they continue and are otherwise unaccounted for, are very significant. When the disease has made more advance, either in the kidney, bladder, or prostate, the urine becomes charged with pus and other signs of disintegrating tissue. It is curious to notice how, even under these circumstances, the urine retains an acid reaction; it is not until it undergoes decomposition, by the retention within it of pus and unhealthy lymph, that it becomes offensive and ammoniacal. A person who is infected primarily with urinary tuberculosis not unfrequently develops symptoms of a subacute form of peritonitis, which shows that the disease has invaded by contiguity more or less of the peritoneum. In this way I have on several occasions seen the disease brought to a termination with a swollen, tender, and tympanitic abdomen.

Tubercle of the kidney in its earliest form is not unfrequently found to be a cause of incontinence and urinary irritability in children. Many children, especially males, who were suspected of stone, have proved to have tubercular kidneys. In an instance that came under observation, the prepuce of a child had been removed with the hope that this might relieve the urinary irritability; excessive renal tuberculosis, with an almost entire atrophy of one kidney, was shown after death to have been present. The following case illustrates some features to which reference has been made:

Case.—E. S., aged 11, a schoolboy, was admitted into the Liverpool Royal Infirmary on June 19th, 1889. About eight weeks before admission the patient after micturition passed some pus, which he

described as being in little nodules. This was followed by the discharge of small clots of blood at intervals after micturition. On admission, in addition to this history, he micturated frequently with pain referred to the penis and neck of the bladder. He was a fair, delicate-looking boy, and for twelve months had often complained of headache. The urine was normal in appearance; sp. gr. 1.010, acid; contained mucus and a trace of albumin. On June 10th I introduced a sound under ether, but no stone could be detected. Volkmann's bimanual method of examining the bladder was then employed, when a nodule at the fundus was distinctly felt. In the evening the temperature rose to 102°, falling in the morning to 97°. The patient was placed on a milk diet, and kept in bed. 24th: It was noted that he was slightly delirious during the night. 26th: Had a restless night. In the morning he passed into a semi-conscious state, with strabismus and other symptoms of acute tubercular meningitis. Urine found to contain tubercle bacilli. 30th: Died, having been unconscious for some hours. *Necropsy.*—Lungs and liver contained recent miliary tubercles. The kidneys were tuberculous and both ureters dilated. The mucous membrane of the bladder was covered with a number of superficial ulcerations. At the fundus a caseous tubercular nodule was found which had been felt during life. Convolutions of brain flattened, lymph at base, ventricles very much dilated; recent miliary tubercles were found in both Sylvian fissures.

In this case, the detection of tubercle bacilli in the urine assisted the diagnosis. In distinguishing doubtful cases, I have generally found the thermometer of great assistance: if there is tubercle, the temperature, with other symptoms, seldom fails to give us a good hint. Renal tuberculosis is frequently found in both organs, though it may be only suspected or advanced in one.

Of the various operations employed for the relief of urinary affections I do not know one that has given more relief than cystotomy; the least favorable cases in my experience have been those where it has been resorted to for conditions arising out of urinary tuberculosis. When undertaken solely with the object of relieving the intense reflex irritation—the frequent micturition—which often attends the early deposit of tubercle in the urinary apparatus from the kidney downward, it is generally a failure. When, however, it is performed for the purpose of giving exit to the products of tubercular suppuration, to pus, lymph flakes, and offensive putrefying urine, then, on physical grounds, it may prove of some service. I have known, in cases of urinary tuberculosis, the desire to micturate to be quite as distressing to the patient though urine was flowing continuously and incontinently by a perineal drain. For the same reason, over-dilatation of the female urethra, with the intention of causing temporary incontinence, does not relieve the reflected irritability of urinary phthisis. The following case illustrates some of the points referred to:

CASE.—A boy, aged 4, came under my care at the Liverpool Royal Infirmary, on the suspicion that he had a stone concealed somewhere in the urinary organs. He had many symptoms of this complaint, but, though he had been sounded several times, no calculus could be felt. He was a child of strumous parents, and was singularly bright and intelligent. Twelve months previously he commenced to wet his bed at night, and to suffer from urinary irritability in the day-time. Occasionally small quantities of blood had been detected with the microscope in the urine, which was invariably acid and opaque. Within two months prior to his admission the urine had been charged with mucus and pus, the expulsion of which from his bladder caused much spasm and suffering. To aid micturition and to mitigate pain, he acquired the habit, which at last became constant, of pulling at his penis. He seemed, as it were, to milk away the urine and what it contained from his bladder. It was under these circumstances he came into the Infirmary, when it was found necessary to give him sedatives freely. The urine, always granular-looking and opaque, now and then contained something which looked more like the white of an egg half boiled than anything else. He was sounded under ether, but nothing abnormal could be detected. Towards evening he generally had a rise of temperature, and there was a hectic tendency. To alleviate the constant pain and spasm of micturition, a median cystotomy was performed for drainage, but with little benefit. The spasm and vesical tenesmus continued unabated. In the course of a month the child died with renal symptoms and a gradual suppression of urine. The autopsy showed nothing wrong with the bladder or urethra. The ureters were dilated, and the kidneys cystic and tubercular. Some of the cysts communicating with the pelvis of the kidney contained thick gummy looking mucus, similar to that which was observed in a more diluted form in the urine; the cyst walls seemed to secrete this viscid matter which, obviously, with difficulty had found its way along with the urine down the ureters. This was the explanation of the dilated ureters, and of the bladder spasms and irritability which led to cystotomy being practised. Without such an explanation it was difficult to understand how the ureters could be dilated and yet no stricture exist in the urethra.

This case makes prominent the following points: 1. That urinary incontinence or irritability in children may proceed from renal tuberculosis. 2. That though cystotomy may relieve the pain and spasm attendant upon the expulsion of the unhealthy urine from the bladder, it does not alleviate the symptoms due to the same urine passing down the ureters. In some cases of this kind there might be reasons for performing nephrectomy or even opening and draining a cystic kidney, so as to prevent the constant spasm or colic which is aroused by the products of the disorganized organ forcing a way along the ureters. 3. It illustrates those extremely rare instances (of which but few specimens are known to exist) where stones in the bladder have been enclosed in fibrous or gelatinous envelopes. By the kind-

ness of Mr. Bickersteth I had not only an opportunity of examining and preserving a well-marked specimen of what these tubercular cysts in the kidney are capable of pouring along the ureters into the bladder, but of ascertaining how these semi-fibrous stones are probably formed. This subject is again referred to in connection with sounding the bladder for stone. The possibility that in a tubercular subject a small stone in the bladder may be wrapped up by a sort of mucoid investment, furnished by a cystic kidney, must not be lost sight of, whether or not the explanation thus offered as to the formation of these calculi is a satisfactory one.

In the diagnosis of urinary tuberculosis in the male, the careful examination of the testes and prostate with the finger often furnishes valuable evidence as to the probability of tubercle existing in the kidney or some other portion of the genito-urinary apparatus which is beyond reach of manipulation. When deposit in these parts exists with signs of functional irritation in the urinary apparatus generally, the suspicion that tuberculosis exists is exceedingly strong, particularly if the patients are adolescent males and the family history points to a strumous diathesis. The following case which I saw, in consultation with Dr. Glynn, in the Liverpool Royal Infirmary illustrates the importance of a physical examination in cases of this kind:

The patient, a youth aged 19, was admitted in Febrary, 1884. *History.*—A strong family history of consumption. Patient had good health up to two years before admission; he then began to fail generally. For twelve months he had been suffering from a short, dry cough, and pain in the region of the kidneys had been present for three months. On admission he was much emaciated. There was pain on pressure in the left lumbar region and much tenderness over the liver. Urine was passed twelve to fourteen times daily, with smarting pain over the pubes both before and after urination; it contained much pus, but no bacteria were discovered. The prostate was found made up of round nodulated masses. In the right testis there was some deposit in the globus minor. These symptoms continued until death took place, on March 8th. *Autopsy.*—Both lungs were studded with miliary tubercles, many of which were commencing to soften. In the transverse and descending colon there were two large tubercular ulcers, about twelve inches apart. The adrenals were full of caseous and calcareous matter. The kidneys were almost destroyed, being occupied by caseous nodules and cavities. The remaining renal tissue was studded with tubercle and the ureters were dilated. The bladder was small and hypertrophied, and the mucous membrane covered with tubercular ulcers. The prostate was softened and riddled with cavities containing caseating matter. The globus minor of the right testis contained a tubercular mass the size of a large pea.

A few remarks may be made in reference to the treatment of a tubercular condition of a system of organs which is more common than

we may at first sight be inclined to believe. In the early stage of the disease the patient requires almost the same attention as in pulmonary phthisis, so far as climate, diet, clothing, and medicines are concerned. I often prescribe small doses of perchloride of mercury, with advantage, before softening takes place. A suitable sea-voyage is sometimes of great service in these cases, when the state of the urine and the act of micturition does not render this out of the question. I have already stated that cystotomy, or other operative proceeding, is not to be advised unless the urine becomes so greatly disordered and the bladder so irritable as seriously to add to the distress of the patient in voiding it. For this irritability I recommend the use of morphine, either by the mouth or in suppositories, in preference, as a rule, to anything else. The quantity of morphine required in some cases of urinary tuberculosis is occasionally considerable, as exemplified in the following instance:

CASE.—In October, 1883, I saw, with Dr. Paton, of Rock Ferry, a patient (A. W., aged 17) who was subsequently admitted into the Liverpool Royal Infirmary suffering from extensive tuberculosis of the prostate and bladder. In January, 1884, in consequence of pain, hæmaturia, and the state of the urine, I performed median cystotomy. This relieved some of the symptoms, but not the irritability. For the latter morphine was prescribed, the daily use of which eventually amounted to seventeen grains. Under this treatment, with cod-liver oil and tonics, he steadily improved. In 1886, he reported himself as perfectly well, but he had not been able entirely to discontinue the morphine habit.

When the urine is very offensive, the bladder may be washed out with some antiseptic fluid, but if this occasions hemorrhage from the tubercular spots, it had better be dispensed with. Guyon employs for this purpose small injections, or instillations as he calls them, of nitrate of silver in preference to general irrigation of the viscus. As a local application to the tuberculous bladder I have found more benefit from iodoform suspended in mucilage in the proportion of five grains to the ounce.

Much stress has been laid on the infection of tubercle, and the necessity of early removing the primary deposits when they can be readily got at. In reference to this point Dr. F. W. Rockwell,[25] of Brooklyn, remarks: "I believe the treatment of tuberculous testicle should be that of strumous disease of any other gland, and that early removal, either of the casous masses or of the whole diseased organ, should be more generally practised than at present."

Tuberculin has been employed to some extent in the treatment of this form of tuberculosis, but no good, so far as I can ascertain, came of it. Writing upon this subject Mr. Hurry Fenwick[26] observes:

"The swelling of the peri-tuberculous tissues led to suppression and retention of urine, and the use of the lymph was liable to produce hemorrhages. The tuberculous deposits could by means of the cystoscope be seen to swell up in the same way as in the skin, and new deposits came into sight." Where, for instance, both ureters are involved, it is obvious from such observations that complete stoppage of urine might be one of its effects.

There is a remote effect of tuberculosis to which I would just refer. We occasionally meet with cases where tubercles have become cured by cretification. Such deposits in the bladder and prostate cause frequent micturition, and give rise to a suspicion that the person is suffering from stone. The history of the case, and the observation that these calcareous spots are fixed and not movable when felt with a metal sound, usually enables the practitioner to diagnose them without much difficulty. I have also seen similar deposits in the kidneys in tubercular subjects.

From the foregoing remarks it will be concluded that though nephrotomy and exploration from the loin may sometimes be called for to relieve pressing symptoms caused by a tubercular kidney, the circumstances which would indicate a nephrectomy must be of a very exceptional nature. The disorder is rarely limited to the kidney which seems to demand an operation, and when this stage has been reached the prospects of curing what is to be regarded as part of a urinary tuberculosis by a nephrectomy must be considered as very remote. A tubercle and a stone represent two widely different conditions.

Deformities and Malpositions of the Kidney.

The kidneys are liable to various kinds of congenital alterations in shape and position with which the practitioner who undertakes their operative treatment should be acquainted.

Probably the commonest variation in shape is where the two kidneys are connected together by a band of renal tissue passing in front of the spine and uniting their lower ends. This is usually spoken of as the horseshoe kidney, the concavity of the curve looking in an upward direction. The general arrangement, so far as vessels and ducts are concerned, is usually in accordance with what would apply where the two kidneys are normally developed. Durham[27] mentions an instance where, in a good example of this unusual disposition, the ureters passed behind the united organs. In some instances the connecting link between the two kidneys is at their upper end, when the concavity of the curve looks downward. This variety is, however, much rarer than the former. Sir William Roberts[27] refers to a speci-

men where the ureters were seen to cross each other on their way to the bladder.

The absence of one kidney has been frequently observed in persons who presented no symptoms of urinary disorder during life. The single organ is invariably hypertrophied and suffices for the entire excretion of urine. In the same way after a nephrectomy a compensatory process takes place in the remaining organ, and so life is sustained. Of 29 cases of solitary kidney collected by Sir William Roberts from various sources, 22 occurred in males, 6 in females, and in one case the sex was not stated.

Then again we have instances of misplaced kidneys such as those where in a lobuled form the entire renal tissue is limited to one side, as well as others, where though one organ is rightly situated the other may be placed over the sacro-iliac synchondrosis or even between the bifurcation of the aorta. Specimens have also been met with where the kidneys were blended together, occupying a median position in front of the great vessels. In a previous section a reference has been made to those kidneys which, by reason of anatomical peculiarities, are capable of altering their positions. In this way painful symptoms due to movement are sometimes produced, and special treatment is required to secure their more complete fixation.

An entire absence of kidney structure has not infrequently been found in the fœtus and the new-born child of full maturity. In such instances further abnormalities in the genital organs are not uncommon.

In diagnosing the presence of both kidneys the electric cystoscope, as I have already stated, has proved of great practical value and has almost led to other methods of search, such as catheterizing the orifices of the ureters, being abandoned.

Dr. Reliquet,[28] of Paris, has published a case illustrating not only a remarkable deformity, but a variety of pathological lesions involving the urinary system. The specimen is one of hydronephrosis of the right kidney and ureter, with calculous pyelo-nephritis of the left organ, which is much hypertrophied. It will be observed from the illustration (Fig. 27) that two large tubes proceed from the degenerated right kidney to the bladder. The outer and larger one is the dilated ureter, while the inner, proceeding from the apex of the kidney downward, is a patent Müller's duct. The latter structures, it will be remembered, are the origin of the Fallopian tubes, the uterus, and part of the vagina, and are generally supposed to be reduced to the veru montanum in the male, where any trace of their persistence is rare. In Dr. Reliquet's case the remarkable clinical symptoms were no doubt due to the compression of the right ureter against

the back of the bladder by Müller's duct. When putrid urine had collected in the dilated right kidney and ureter, sufficient to overcome the resistance of Müller's duct (which was also distended with fluid), it escaped into the bladder, and was voided during micturition. The

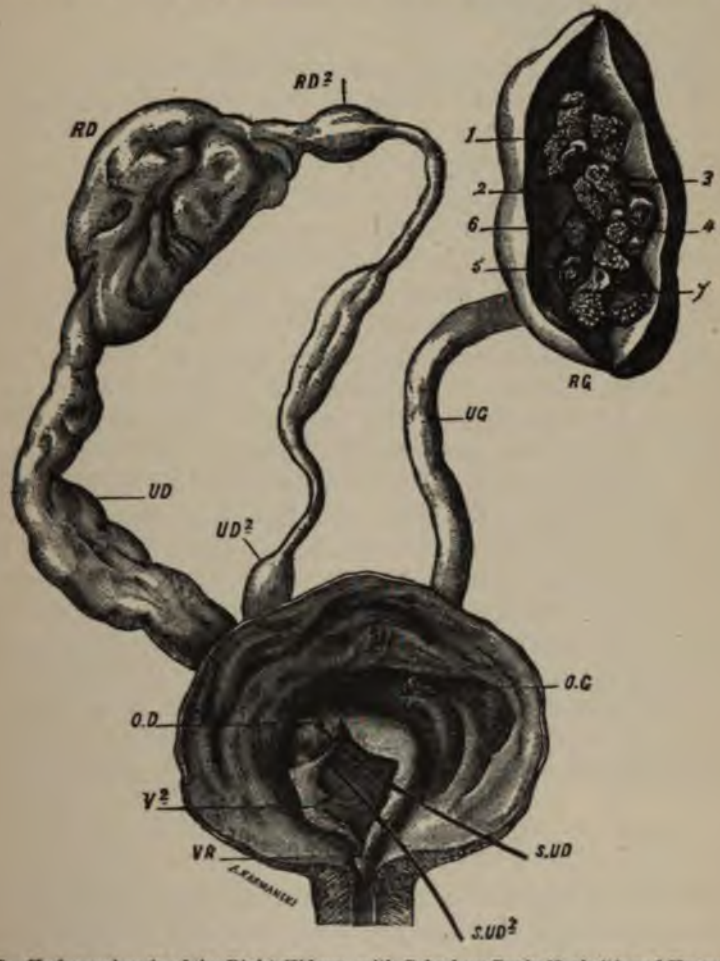

FIG. 27.—Hydronephrosis of the Right Kidney, with Calculous Pyelo-Nephritis and Hypertrophy of the Left. *R.G*, Left kidney, containing calculi, marked 1-7; *U.G*, left ureter; *O.G*, orifice of left ureter in the bladder; *R.D*, right kidney; *U.D*, right ureter; *O.D*, orifice of right ureter in the bladder; *R D²*, *U.D²*, upper portion of Müller's canal; *U.D³*, *V³*, lower portion of Müller's canal; *V.R*, verumontanum; *S.U.D*, bougie in right ureter; *S.U.D²*, bougie in lower portion of Müller's canal.

bladder orifices of both ureters were patulous, and reflux of urine on the left side was no doubt the cause of the calculous pyelitis. The pressure of Müller's duct prevented this back flow of urine along the ureter on the right side, hence the different results observed in the

two kidneys. The specimen was taken from a man forty-five years of age. That the persistence of Müller's ducts may prove a serious obstacle to the passage of urine into the bladder there can be no doubt, from the evidence afforded in this as well as in other cases; while, on the other hand, such an abnormality may exist without producing symptoms.

Sufficient illustrations have now been adduced to show many of the difficulties that may arise both in diagnosing and treating states of renal disease under such circumstances. In the case of a patient urgently requiring surgical relief for a renal affection, the possibility of his having only a single kidney must never be entirely laid aside. Persons so situated, as, for example, where a stone is impacted in the pelvis or ureter of the solitary organ, would doubtless have lost their lives, in several instances, unless such a contingency had been recognized and promptly acted upon. And so in the course of surgical procedures, as, for example, nephrectomy, we must not forget either that the organ we are in search of may be a solitary one, or that it may be so connected with its fellow, as in the case of the horseshoe kidney, as to add considerably to the difficulty as well as the risk of dealing with it. A reasonable knowledge of the deformities and malpositions of the kidney will in some instances enable the surgeon to recognize them beforehand; in others it will suggest to him the best course to take when in actual practice he meets with them, while in a third variety it will enable him to explain symptoms which, in naturally disposed parts, would be simply anomalous. It is with these objects in view that a brief consideration of this aspect of the subject has been here introduced. However interesting it might be, I have purposely avoided discussing it from the developmental standpoint as being hardly within the scope of this article.

Hydatid of the Kidney.

Cysts of this kind connected with the kidney are of comparatively rare occurrence, and are more frequently met with in other parts of the body. As Thomas[29] observes, "it is generally found to exist with greater or less frequency wherever man and his faithful friend and companion, the dog, are associated. It has been met with in Europe, Asia, Africa, North and South America, and in all the colonies of Australasia; while chilly Iceland and sunny Australia vie with each other in offering this unwelcome immigrant a congenial home." As to its prevalence in America Dr. William Osler,[30] of Baltimore, observes: "In this section of the country it is rarely met with, and in the inspection of over 800 bodies only three instances have

been found." So far as the kidney is concerned, in a recent article by Dr. William Gardner,[11] of Melbourne, it is stated: "In Davaine's collection of 566 cases of echinococcus disease, observed in man, 30, or 5.3 per cent, occurred in the kidney. The left kidney is found to be much more frequently the seat of the disease than the right, and men are twice as often attacked as women. Out of 68 cases collected by Béraud 48 opened into the pelvis of the kidney, with the development in some cases of pyelitis."

The frequency with which kidney hydatids communicate with some part of the urinary passages, and are thus voided, is a matter of general observation. In this way a spontaneous cure is sometimes brought about and the precise nature of the disorder may pass unnoticed. This may to some extent explain the supposed rarity of renal infection. In a case I have elsewhere referred to, which came under my notice, it was for some time supposed that the woman was suffering from renal calculus until the urine was examined by the microscope and the parasite detected.

When small, hydatids of the kidney may occasion no symptoms, these being for the most part due either to the rupture of the cyst and the discharge of its contents into the pelvis of the viscus, or to the pressure exercised on the organ by the increasing dimensions of the growth. This increase has sometimes become so considerable as to interfere with the function of the part, thus leading to a compensatory hypertrophy in the opposite organ. Again it has been noticed that an hydatid of the kidney has led to a mobility of the organ for which an operation has become necessary, and thus the parasite has been accidentally discovered. An hydatid involving the kidney can sometimes be distinguished, on manipulation, by a characteristic fremitus or kind of friction-feel. This is not always recognizable, and its absence has therefore but little significance.

The most trustworthy method of diagnosis is that obtained by the exploring trocar, which permits of the withdrawal of some of the fluid contents and the recognition of the characteristic hooklets by the microscope. By the detection of these distinguishing products in the fæces I was able, in a case referred to under the section on hydronephrosis, to diagnose a pelvic hydatid of considerable standing. It must, however, be remembered that the introduction of a very fine trocar and cannula into an hydatid cannot invariably be done with impunity, and when this method of diagnosis has necessarily to be adopted the surgeon should be prepared with all the appliances for at once proceeding with whatever radical measure may be selected. Gardner[11] observes: "Simple puncture, although generally devoid of risk, has been known to cause sudden death, sometimes apparently

from shock. The objection to puncture as the mode of treatment for internal hydatids, however, lies less in the occasional perils of the operation than in its frequent inefficacy." It has been stated that these symptoms are due to the poisonous nature of the contents of these cysts and their absorption, but I do not think there is sufficient proof of this.

Hydatid cysts sometimes assume a considerable size. In one case operated upon by Spiegelberg,[32] a woman, aged forty-two, had a retroperitoneal echinococcus cyst connected with the omentum, the large and small intestines, and the right kidney, which was mistaken for an ovarian cyst; the fibrous capsule and a portion of the right kidney were removed. The patient died twenty-six hours after the operation.

As a rule the cyst is situated in the substance of the kidney, though at times it is found insinuating itself between the capsule and the gland. The tumors are liable to certain accidents, such as rupture from the effects of muscular as well as outside pressure, and in this way a spontaneous cure may eventually be brought about. They often form adhesions to surrounding parts and so implicate organs other than those in which they may originate. Inflammation occasionally occurs within them, and suppuration may proceed to their spontaneous bursting and the escape of their contents, either into a natural outlet as the urinary passage, or even into the intestines. They may degenerate, as Sir William Roberts has demonstrated, and be converted into cretaceous masses consisting of phosphate of lime, cholesterin plates, and fatty granules.

Surgically speaking, the treatment of these cysts relatively to the kidney consists, after medical measures have failed either to eliminate or to poison the parasite, in first exploring them with an aspirator needle and then proceeding to open them freely for the purpose of clearing out their contents and draining them. In the case of a renal hydatid this should be effected through the loin by such an incision as is described in connection with nephrotomy, by means of which the cyst can be effectually opened, scraped, and drained. In certain instances and to facilitate the last-named object the side of the opening in the cyst may be secured by suture to the corresponding lips of the cutaneous incision. In the case of the kidney, as Dr. Gardner observes, there are instances in which it is necessary to select nephrectomy; this conclusion, however, is not likely to be arrived at until the sac has been fully explored. Dr. Bond's mode of dealing with renal hydatids[33] is referred to by Dr. Gardner in his paper as being the ideal method, and is also commended because time is saved in the after-treatment; he thus illustrates it:

CASE.—A married woman, aged 35, suffering from hydatid of the left kidney. The usual lumbar incision was made and the cyst exposed and freely opened, after being punctured with a hollow needle. The sides of the cyst were grasped with forceps, and by douching, a large mother-cyst was withdrawn. The envelope was dried and closed with a continuous suture, and then the external incision was adjusted in the usual manner. The wound was dressed for the first time on the eighth day and found to be firmly united. She left the hospital on the fourteenth day.

Tumors of the Kidney.

The subjoined list of tumors, given in tabular form, shows at a glance the various kinds of enlargement of the organ, or of the structures immediately connected with it, which clinically constitute a renal tumor. To render the table complete we include, on the one hand, some inflammatory and other swellings, which though not neoplasms, are at the bedside regarded as tumors; and, on the other, some rare or minute growths which are definite pathological new formations, though of insignificant clinical importance.

- I. Of congenital origin.
  - Sarcoma.
  - Cystic disease.
  - Hydronephrosis.
  - Cavernous tumors.
- II. Of post-congenital origin.
  - Extra-renal.....
    - Abscess.
    - Cysts.
    - Myxo-lipoma.
    - Tumors of the adrenal.
  - Pelvic.....
    - Hydro- and pyo-nephrosis.
    - Villous tumor.
    - Carcinoma.
  - Glandular and capsular...
    - Hydatid cysts.
    - Cystic disease.
    - Tubercular disease.
    - Lymphadenoma.
    - Syphilitic deposits.
    - Lipoma.
    - Fibroma.
    - Sarcoma.
    - Adenoma.
    - Carcinoma.
    - Secondary growths.

The tumors are arranged primarily in two groups. The first includes those of congenital, and the second those of post-congenital, origin. This arrangement is warranted by both clinical and pathological experience. Clinically we recognize the rarity of renal tumors during late childhood and early adult life, while they are comparatively not uncommon before five or after thirty. Pathologically it is

found that the early growths have a minute structure unlike the later growths, and one which indicates that they, like the congenital cystic disease and hydronephrosis, are referable to abnormalities of development. It is in the congenital sarcomata only (though these rarely show themselves late in life) that a complex minute structure is met with, including such various tissues as striped muscle, fat, and other connective and glandular tissues, and pointing to their origin from structures derived from the Wolffian body or intermediate cell-mass, and included in the substance of the true kidney. To congenital cystic disease a similar origin has been ascribed; the cysts are said to be derived from the remains of the Wolffian body (Shattuck). Hydronephrosis the result of congenital abnormalities is much more frequent than the cystic disease, and has a considerably greater clinical importance. Dermoid cysts are mentioned, but it is doubtful if any examples have actually been met with in the human subject. Cavernous tumors are small, and give rise to no symptoms. They probably correspond in origin and growth to similar tumors in the skin.

The post-congenital tumors are subdivided into three groups according to their anatomical position. Of those which are extra-renal, abscess has already been dealt with. Extra-renal serous cysts are rare, and their etiology is not very well understood. Large myxo-lipomatous tumors occasionally grow from the peri-renal fat, and are properly included among the renal tumors, as this fat has a definite anatomical relation to the kidney. Tumors of the adrenal are often so intimately connected with the kidney that it is impossible to differentiate them clinically, as may generally be done when the enlargement is in the spleen, liver, glands, or bowel. And when the tumor is malignant it infiltrates the kidney at such an early stage that it may be impossible, even post mortem, to decide in which organ it originated.

The pelvic group include hydro- and pyo-nephrosis, already treated of, villous tumor or papilloma, and carcinoma. The pelvic mucous membrane has the same structure as the lining membrane of the bladder, and it is, therefore, as we should expect, subject to the same varieties of new growth. Villous tumor is uncommon, but may attain a considerable size. It is exactly like that which grows in the bladder. Squamous-celled epithelioma is the usual kind of carcinoma met with in this locality; it is more frequent than the preceding. Colloid carcinoma is the only other variety. It is very rare.

The glandular and capsular group is composed of many species, of which tubercular disease, sarcoma, and carcinoma are by far the most important. Hydatid cysts may occupy any position in regard

to the organ. They are much less frequent here than in the liver, but can hardly be regarded as curiosities. Cystic disease is rare. It may give rise to great enlargement of one or both organs with symptoms of Bright's disease. The tubercular affections have been described. Lymphadenomatous growth in the kidney sometimes forms a part of Hodgkin's disease. Syphilitic gummata are distinctly rare in the kidney. When seen they are found accidentally post mortem. Unlike similar deposits in the liver they do not appear to attain clinically recognizable proportions. Lipoma in the kidney substance is rare and small. The fibromata described are very small, but are frequently observed. Neither of the two latter have any clinical significance. Of the sarcomata the small round-celled variety is that which is almost constantly met with; but some very interesting specimens of a vascular or hemorrhagic tumor of the kidney have been recorded, and it is not decided whether they should be called angeio-sarcoma or hemorrhagic carcinoma. Adenoma occurs as small, more or less encapsuled tumors, having a tubular or cystic structure. The typical carcinoma is also tubular and sometimes cystic; but there is at present no satisfactory account of the pathological varieties which may occur in this region. Secondary sarcoma and carcinoma are less frequent in the kidney than in the lungs or liver, and the growths rarely attain sufficient size to seriously impede the functions of the organ, except in the case of the direct infiltration of a neighboring tumor.

I am indebted to Mr. F. T. Paul, of Liverpool, for revising for the purposes of this work, so far as renal tumors are concerned, the classification which was originally drawn up by him as an introduction to a discussion on the new growths of the bladder, prostate, and kidney." The investigation on which this is based was undertaken at the request of the British Medical Association by a committee consisting of Mr. Paul, Mr. Rushton Parker, Dr. Alexander, and myself.

From the foregoing classification it will be seen that tumors of the kidney may for clinical purposes be considered as of two kinds, namely, innocent and malignant. The broad distinctions between these two classes are those which are recognized as being applicable to growths generally wherever they may occur in the human body. It will be well, in the first place, to ascertain the circumstances which would lead us to believe that a kidney is the subject of a growth or enlargement bringing it under either of these two denominations, and the features which, when present, enable us to differentiate between varieties of these formations.

It is generally admitted that among abdominal enlargements and tumors those taking their origin in the kidney are probably the most

difficult to diagnose. They are not unfrequently associated with ascites, and when this complication exists the task of drawing distinctions, especially in stout persons, is by no means an easy one. The encroachments proceeding from other organs such as the liver, spleen, suprarenal capsules and the growths connected with them, for instance hydatids, present other sources of embarrassment. Further, we have to take into consideration the possibility of a renal growth being initiated by one of those tumors taking their origin in the capsule of the kidney or in the connective tissue surrounding it, which have more recently been described by Dr. Vander Veer[35] under the title of "Retro-Peritoneal Tumors." Then there are abnormalities in the position and relations of the abdominal viscera of not unfrequent occurrence which have added in no small measure to the difficulties connected with making a diagnosis. In these ways sources of doubt in some cases may easily arise, rendering it almost impossible to arrive at a conclusion without the assistance of some kind of exploratory operation. In coming to a diagnosis, or at all events in endeavoring to do so, it is best in most cases to proceed step by step by what is well recognized in surgery as the process of exclusion. In these investigations we shall do well, where it is necessary, to avail ourselves of the assistance that is often rendered by the aspirator and exploring needle, by a careful quantitative, qualitative, and microscopical examination of the urine, in addition to the ordinary modes of manipulative examination. In some cases the cystoscope, in determining the action of the respective ureters as well as the nature of the fluids they emit, will prove of service. Again, instances will occur where in defining the nature and limits of a tumor in the kidney such a complete relaxation of the abdominal parietes will be required as can only be secured by the administration of an anæsthetic. In the female an examination of the pelvic contents by the vagina may be called for, for instance in the differential diagnosis between an ovarian tumor and an enormous fluid dilatation of the kidney, as referred to in connection with the subject of hydronephrosis. In a male child, in a doubtful kidney case, I remember an instance where the detection, by the finger in the rectum, of a stone impacted in the lower end of the ureter proved of material importance. Then, again, the fæces should not be allowed to go without inspection; the absence or presence of bile in them may throw some light on an obscure case. Writing in reference to the diagnosis of retro-peritoneal tumors Dr. Vander Veer remarks as being of service "the rectal insufflation of hydrogen gas, with the distention of the stomach; more especially where a careful examination has been made before and the percussion areas have been outlined upon the abdomen. The pro-

cess of insufflation should be watched, that the relation of the intestinal tube to the tumor may be established." This method of insufflation has, I know, been advantageously used in determining the nature of doubtful abdominal growths. By these means and in these directions search may often be advantageously made.

The points upon which stress has been laid, as distinguishing kidney tumors of sufficient dimensions to be appreciable by manual examination, are these: That the large intestine is in front of the growth. This is not generally applicable, for, as Mr. Bruce Clarke[36] remarks, the colon is often displaced congenitally. This coincidence was found in a case which occurred under Dr. Black's care in St. Bartholomew's Hospital. As renal tumors grow in directions where the resistance is least, there is seldom anything like a lumbar projection; as Sir William Jenner remarked,[37] "Tumors due to disease of the kidney enlarge in front; while abscesses and other lesions which may simulate renal tumors often cause considerable posterior projection." The kidney is rounded naturally and remains so as it grows; as Jenner observes, "it has no sharp edges and in disease never loses this peculiarity." Kidney growths are rarely influenced materially by inspiration. This, however, is not of universal application, for as Morris says, "I have seen a renal tumor descend as much as an inch by a deep inspiration and fall forward or backward by its own weight with the movements of the body." The shape of a tumor, if, for instance, it is a very pendulous one, may in some measure determine this, as I have had occasion to notice. The position of the most prominent portion of the tumor relative to the adjacent parts is also of importance to notice. This usually corresponds somewhere about with the line of the umbilicus. It should also not be lost sight of that on the right side alterations in the shape and position of the liver have been mistaken for kidney tumors, while on the left the spleen and the corresponding kidney, in a similar way, have been confounded. A surface inequality, as, for instance, an interposed line of resonance on percussion, will often serve to indicate on careful examination these regional distinctions. Some of these diagnostic points are well shown in the accompanying figure from a paper on congenital sarcoma of the kidney by Mr. Paul.[38]

Though in the majority of cases we shall be safe in concluding that a kidney is the subject of a tumor, it may hardly be possible to differentiate between the varieties of new growth in contradistinction to those dilatations and distentions of the organ which have occupied the earlier portions of this article. I may, however, mention some general conclusions derived from experience which may be of assistance in enabling us to make this distinction. The smaller

kinds of innocent growths, which do not attain any considerable size, including cysts, are rarely discovered till after death; nor do they appear to cause symptoms or to be otherwise than incidental to other diseases. In the case of kidney symptoms occurring in syphilitic or scrofulous subjects, the possibility of a gumma or a tubercle will not be forgotten.

Turning to the malignant type of tumors, their often considerable size and rapid growth will not fail to arrest our attention. These in their development are either primary or secondary. The discovery of a primary malignant growth in any of the adjacent parts such as the rectum, prostate, bladder, intestines, or the breast, where the diagnosis is more readily made, will afford an explanation for the sequence of symptoms which now point to the kidney. Medullary cancer (sarcoma) in children, when it affects the kidney, sometimes assumes enormous dimensions (*vide* Fig. 28). When cancer involves the kidney in a primary form it is usually limited to one, in secondary cancer both organs are generally implicated. As stone in the bladder, as an irritant in a cachectic subject, is believed sometimes to be the exciting agent of a cancer, so may it be in the case of the kidney. A villous growth in the bladder, as I have seen in more than one instance, is occasionally attended with a similar one in the kidney.

FIG. 28.—A Congenital Renal Tumor of the Left Side Weighing Six Pounds in a Child Aged One Year. It shows the characteristic displacement of the colon, and the general interference which must have been caused to other organs by its immense size. (From a post-mortem photograph.)

The symptoms of a renal neoplasm are by no means well defined or constant. An increased bulk in the organ is probably the leading feature in conjunction with what I would speak of as the natural history of its development and the circumstances attending it. Irritation of the bladder, hæmaturia, personal appearance, pain in the part, œdema of one or both legs, engorgement of the abdominal cutaneous veins, all have their significance; these indications of a structural lesion must be weighed in conjunction with the application of those diagnostic tests to which reference has already been made.

Lastly comes the question as to how these neoplasms are to be

treated—to what extent is it legitimate to remove them, by the extirpation of the kidney through either a lumbar or abdominal incision? This can only be answered by carefully weighing in a given case the questions: Can the disease be entirely removed at no very great and immediate risk to life, so as to give the patient a fair chance of future immunity? or, Are the symptoms of such intensity, so far, for instance, as pain, bleeding, or urinary retention are concerned, as to justify the surgeon, in the absence of all other modes of relief, in making any attempts of an operative nature that may seem to be within reach? To both of these questions there are cases of an exceptional nature where the answer must be, in the interest of suffering humanity, in the affirmative. The outlook in the growths of early life, there can be no doubt, is most unfavorable. As Mr. Paul observes, "that all these congenital tumors are malignant is clearly established by a most valuable paper drawn up by Mr. Sutton,[*] in which he shows that out of thirty-five operations for the removal of renal sarcoma in children under six years of age fifteen recovered, but all died within a year from recurrence of the growth. Thus, however interesting it is to us as pathologists to study cases such as these, it is a somewhat disheartening reflection that up to the present they remain hopeless from the clinical point of view." A reference to the methods of performing nephrectomy and operations for the exploration of the kidney will be found in a preceding section.

It has been stated that some of these neoplasms may be checked in their course toward destruction by various agencies; of these, iodide of potassium and Chian turpentine appear to have given some slight evidence of their efficacy in this direction.

It is too soon as yet to say anything definite in regard to the use of the erysipelas toxines in the treatment of malignant neoplasms of the kidneys or other organs. Their therapeutic value, if they possess any, can be demonstrated only by actual experience in a long series of cases.

DISEASES OF THE URETERS.

The tubular connections between the kidneys and the bladder, by means of which the urine is carried from the glands where it is secreted to the reservoir in which it is temporarily contained, have recently received a considerable amount of attention from a pathological as well as a surgical point of view. In fact the surgery of the ureters is now as progressive as that which applies to the parts these tubes connect. What has been already accomplished stands out in remarkable contrast with the state of things which existed prior to

the present decade and cannot fail to serve as an incentive to further advances. When we consider that an injury to a ureter is almost certain to result in the ultimate loss of the corresponding kidney, while its obstruction by a calculus may be attended by still more disastrous consequences, it is almost impossible to overestimate the importance of the subject. This importance is considerably enhanced by the knowledge that in the whole of their course these tubes are within reach of the surgeon without any very great difficulty so far as the operative procedures are concerned.

Injuries of the Ureters.

Protected as they are by the parts surrounding them, it might appear that lesions of these tubes are well-nigh impossible. This, however, is not the case, for we shall find examples constantly occurring of their rupture, laceration, and division.

Rupture of a ureter is usually caused by the application of very great violence to the trunk or abdominal region as by crushes and squeezes. It may also be occasioned by gunshot injuries or by the bursting of explosive shells, where the lesions are usually extensive and complicated. A ureter has been severed by a stab wound, and accidentally divided by the knife of the surgeon in the course of an operation. Its lining membrane may be lacerated sufficiently by the descent of a rough calculus to cause a cicatrix and a subsequent stricture or narrowing of the tube. Rupture from external violence most frequently occurs in immediate proximity to the pelvis of the kidney. In one instance I saw, where it was complicated with fracture of the lower ribs, I have no doubt it was caused by the man, while in a state of intoxication, being squeezed between a heavy wagon and a large stone. The patient died the day following his admission to the Liverpool Northern Hospital. Some blood-stained urine was removed by the catheter, but beyond this, and the general nature of the injury, there was nothing to indicate that the left ureter had been torn across immediately below the kidney, as shown by the autopsy. The late Mr. Stanley[10] recorded two instances of this injury: one where the diagnosis was verified by an examination after death, which took place ten weeks after the injury, and the other where, though the symptoms pointed to the probability of this lesion being present, the patient recovered. In both of these cases a prominent feature was the collection in the cellular tissue behind the peritoneum of fluid resembling urine, which had to be removed by tapping. Mr. Poland[11] has also recorded another instance where, consequent on a crush between a railway platform and a moving train, a ureter was

ruptured, the patient surviving, with other serious injuries, for 135 hours.

When the fact cannot be demonstrated to the eye, the possibility of rupture of a ureter must be judged of largely by the nature of the injury and its attending circumstances. In a case reported by Dr. Collins where this lesion must have occurred, and which is more fully referred to in connection with the subject of traumatic hydronephrosis, the injury was caused by a cart-wheel passing over the abdomen and pelvis of a child. The patient was much collapsed, there was fracture of the left lower ribs and right innominate bone, and the catheter drew off only a drachm or so of sanious fluid. The distention test showed that the bladder was not ruptured, though the urine was blood-stained for some days. The patient eventually developed a right hydronephrosis. In other cases a ruptured ureter has been accompanied by considerable lateral abdominal distention extending to the loin and by slight hæmaturia. The effusion of a watery fluid, somewhat resembling very dilute urine, in the neighborhood of the injury has also been noticed in several instances. In one of those cases recorded by Mr. Stanley it is stated that the fluid was found to contain unequivocal evidences of urea, and from its appearance seemed to justify the conclusion that it was of a urinous nature. In the second of Mr. Stanley's cases a cystic collection of a somewhat similar fluid was found communicating with the junction of the pelvis of the kidney and the ureter, where the injury had taken place. In commenting upon these cases the author observes: "They show that the rupture of the ureter or pelvis of the kidney may present this remarkable feature when contrasted with the consequences of a rupture of the bladder: while in cases of the latter injury symptoms immediately arise, directly pointing to the organ which has suffered, in cases of the former kind (the lesion of the ureter or pelvis of the kidney) no symptoms may immediately arise leading to a suspicion of injury to any part of the urinary apparatus."

In a paper which deals very fully with the subject of rupture of the ureter Mr. H. W. Page[43] records an instance in his own practice where it was extremely probable that this lesion existed. A male child five years of age was run over by a cab and sustained abdominal injuries, which were followed by slight hæmaturia and the formation of a swelling in the right iliac fossa. As the symptoms did not improve and the temperature rose, about a month after the injury the abdomen was opened in the right linea semilunaris and forty ounces of fluid were evacuated from a retro-peritoneal swelling. This fluid was analyzed and shown to contain half its bulk or somewhat less of normal urine. In spite of careful drainage a high temperature re-

turned, the discharge became urinous and offensive, and the powers of the patient began to flag. Two months after the injury nephrectomy was performed and was followed by complete recovery. The kidney was found in an advanced state of pyelonephritis.

The conditions under which a urinous effusion takes place some days after rupture of a ureter is one that deserves something more than a passing notice. One would almost be inclined to suppose that the escape of urine either directly from the torn pelvis of the kidney or from the open ureter must be followed by all the rapid and disastrous consequences which ensue when it is effused, often in conjunction with blood, among either normal or damaged tissues. The occurrence of these symptoms is certain and unmistakable so long as no vent is provided for urine which is thus poured out. No exception to this can be brought forward, save in such instances as I shall presently illustrate. Why this immunity from well-recognized consequences should exist in the case of a ruptured ureter, where one would naturally expect an extravasation of urine to follow, is a point of considerable interest and importance.

In the records of a case with remarks by the late Mr. Poland and Dr. Moxon some light, I think, is thrown upon this aspect of the question. Stress is here laid on the condition of the kidneys as observed in this and other instances, it being stated by Dr. Moxon that the vessels were blocked with ante-mortem clots. It is almost impossible to imagine that a rupture of a ureter could be effected without the application of a considerable amount of violence to the part. Even supposing that the requisite force was limited to the ureter and continued in the form of traction until the tube snapped, this would almost necessarily imply more or less injury to the corresponding kidney. Is it not likely, considering the sympathies existing between the two kidneys, that the infarcted condition of the blood-vessels of both organs, referred to by Dr. Moxon as of ante-mortem origin, is a provision in the first instance for the substitution of a kind of urine which is incapable of proving destructive to the tissues with which it may come in contact? Thus time is afforded for repair, or to enable the opposite organ by a compensatory hypertrophy to take up the whole work if necessary.

This conclusion suggested itself to me in connection with the following case. It was one of stricture, with extravasation of urine into the scrotum, occurring in a person suffering from Bright's disease of the kidneys. Though the extravasation had come on suddenly and had existed for twenty-four hours unrelieved, there were no signs of acute inflammatory action and commencing gangrene, such as are usually expected. However, the tension being considerable, the

parts involved in the extravasation were incised. As the fluid escaped from the incisions, it was noticed that it had not the strong ammoniacal odor which is so perceptible in such cases. I was somewhat puzzled for an explanation, as I felt sure that the case was one of extravasation, and not of acute scrotal œdema. How was it then that extravasated urine failed to create gangrene? I collected some of the fluid as it trickled through the wound, and compared it with that subsequently drawn off by the catheter. They were found to be identical, and in both there was almost a complete absence of urea. This then, to my mind, solved the mystery, and explained that, as there was no urea to decompose, there was no source for the production of the ammonia by which the destruction of tissues in connection with extravasated normal urine is effected. By the absence of urea the urine was rendered chemically harmless to the tissues with which it came in contact.

The view I have ventured to express as explaining certain points connected with the pathology of injuries to the ureter and pelvis of the kidney has some weight given to it by a remark made by Mr. Holmes in connection with this subject: "If it could be shown that a wound of the ureter or a lesion of that organ could suspend the true secreting function of the corresponding kidney, while it left its percolating function intact, or even if any theoretical explanation of such a result could be given, the case would be quite clear, since the opposite kidney would have double secretive work to do, and the urine passed by the urethra would be scanty, with excess of lithates."

The next point to which attention must be given is the fact that, as in the case of the urethra, wounds and lacerations of the ureters are liable to be followed by dense and contractile strictures. In this way the kidney may be destroyed either by a process of hydronephrosis as previously referred to, or by complete atrophy and absorption. Here the law of a compensatory hypertrophy steps in and the life of the individual is preserved, although by the necessary absence of one kidney it is continued under conditions of living associated with increased risks, as can readily be understood.

We have now before us the various contingencies the surgeon has to face in connection with the treatment of a rupture of a ureter. Putting aside complications involving neighboring viscera, they may be summed up as collapse, hemorrhage, extravasation of a diluted and comparatively innocuous urine, and the probabilities, so far as the near future is concerned, of a strictured if not an impervious ureter, and a hydronephrotic or atrophied kidney. In view of the treatment that these conditions may require immediately or prospec-

tively, it will be well to take a glance at some of the more recent observations that have been made bearing upon this matter.

Van Hook [3] in a valuable paper on the surgery of the ureters takes exception to the performance of nephrectomy, a practice which has hitherto had some advocates, in cases where the duct has been accidentally divided, as, for instance, in the course of a laparotomy. He observes further: "Kidneys are not to be sacrificed for fistulæ, partial obstruction by valvular folds causing intermittent hydronephrosis, and strictures of the ureter that interfere to a greater or less extent with the functional activity of the ducts, without exhausting every effort to correct the morbid condition."

This principle finds forcible and successful illustration in a case recorded by Küster," where, in a boy who, by congenital defect, possessed but one kidney, a ureteral fistula was closed and the urine compelled to traverse its natural channel. This was effected by exposing the kidney by a posterior incision. The ureter, on being opened below the sacculated gland, disclosed a stricture which was resected and the tube was then implanted into the hydronephrotic sac. A lumbar fistula remained for several months, but was finally cured by a secondary operation.

The circumstances under which it may be necessary for the surgeon to make an attempt by exploration to secure the repair of one of these ducts and thus to avert, immediately or more remotely, the sacrifice of a kidney, seem to be limited to those instances where the evidence is reasonably conclusive that the ureter is, or is likely to become, impermeable to urine. In a severe abdominal injury, as a crush or a squeeze, though there is a possibility of such an occurrence, the practitioner would hardly feel justified in proceeding with either a lumbar or an abdominal exploration on a mere undemonstrated suspicion of ruptured ureter, and in the absence of other lesions requiring it.

A persistent hemorrhage of apparently renal or ureteral origin, with or without a cystitis due to retained blood clots, as in the case recorded in my account of ruptured kidney, or the presence of a lumbar or post-peritoneal swelling due to the pressure of extravasated blood or pus in increasing amount or to urinous effusion or extravasation, as mentioned in connection with the symptoms of rupture of a ureter, either of these would certainly more than justify an exploration from the loin of the kidney and its ureter. The latter are, as a rule, outside the peritoneum, and, in the locality where ruptures of these viscera most frequently happen, an exploration is attended with no additional risk. If the ureter is discovered to be ruptured an attempt to effect its immediate repair, with the objects of saving the

kidney and maintaining the efficiency of the entire urinary apparatus, would then be entertained.

Again, after a severe injury to the side, when, though at the time it was quite possible but not proved that rupture of a ureter had occurred, the subsequent development of a hydronephrosis would warrant the exploration of the corresponding ureter with a view to undertaking its repair. In illustration of this I will mention a case of Fenger's which is thus epitomized by Van Hook: "Traumatic stricture of the ureter close to its entrance into the pelvis of the kidney; intermittent hydronephrosis. The patient, forty-seven years of age, had sustained an injury thirty-four years previously. After ten years the hydronephrosis developed. Operation of lumbar nephrotomy disclosed no calculi. The ureteral entrance could not be found through the renal opening. The dilated pelvis was opened, but still the passage through the ureter could not be discovered. The ureter was now isolated and its upper end found to be imbedded in cicatricial tissue for half an inch. Lower down, though small in calibre, the duct was normal. A longitudinal incision one centimetre in length was now made in the ureter just below the cicatrix. The stricture was one centimetre long. It was incised upward into the pelvis. The ureteral wound was now stitched longitudinally, after the manner of the Heineke-Mikulicz procedure for the treatment of pyloric strictures. No bougie was left in place. The patient made a good recovery without return of the hydronephrosis."

In the next place an attempt to secure direct repair in preference to at once proceeding with a nephrectomy, would be open to the surgeon, who in the performance of an abdominal operation accidentally severed or wounded a ureter. Several published instances of this accident in the hands of competent operators will be met with.

The possibility that a person was born with, or that circumstances have brought about the existence of, a single working ureter, upon the integrity of which the existence of the individual absolutely depended, must not be lost sight of in connection with severe abdominal lesions where total suppression of urine immediately following the injury is a prominent feature. A ruptured ureter might account for this and call for a prompt exploratory operation, otherwise a speedily fatal result would be unavoidable.

Under such conditions, and possibly some others, the exploration of a ureter may be undertaken with the view of repairing it if found to be injured. We may now proceed to notice in detail the modes which have been adopted to secure the continuity of so small a tube.

Van Hook thus refers to observations on several points connected with the ureters (in woman) which he considers are not correctly or

fully stated in some text-books: "Upon examining the ureters of over twenty bodies he never found one over fifteen inches long, the average being between ten and twelve inches in length. The ureter when stripped from the peritoneum may be drawn out from two to four inches. The curvature of the abdominal ureter has its convexity directed inward, while the convexity of the pelvic portion is turned outward. The pelvic portion of the ureter describes a very strong curve, almost the arc of a circle, since the duct hugs the bony wall of the pelvis very closely. Hence the portion of the ureter opposite the uterus is at some distance from that organ, and as the ureter approaches the base of the bladder (which it enters at a point near the middle of the distance between the urinary meatus and the cervix), it curves rather sharply forward and inward, so that the point in the duct nearest the cervix is below and behind the posterior lip. It must not be forgotten that the ureter has three points of diminution of calibre which may give rise to mistakes in the search for pathologic stenoses. The first is between one and a half and two and a half inches from the pelvis of the kidney, according to Dr. Tanquary's measurements. The second is at the junction of the pelvic and vesical portions. The third when present (found in three out of five subjects) is just where the ureter crosses the iliac artery."

Referring to the modes of approaching the ureters for surgical purposes the same author observes: "The extra-pelvic portion of the ureter is most readily and safely accessible for exploration and surgical treatment by the retro-peritoneal route. Hence all operations upon the ureters above the crossing of the iliac arteries should be performed retro-peritoneally, excepting those cases in which the necessity for the ureteral operation arises during laparotomy. The intra-pelvic portion may be reached by incision through the ventral wall, the bladder, the rectum, the vagina in the female, the perineum in the male, or by Kraske's sacral method."

The processes of dealing with a wounded or a stenosed ureter may be described as (1) by suture, and (2) by external or internal implantation, the former being sometimes utilized for merely temporary purposes.

There seems very little doubt that, as in the case of the urethra, longitudinal wounds of the ureter, provided only the drainage is sufficient, heal spontaneously without causing subsequent contraction. This is evident as the result of experiments on animals as well from what has followed accidental incisions, or those made into these tubes for the removal of calculi. And the same degree of treatment is applicable to those cases where the wound takes a transverse direction though it fails in effecting a complete severance of the ureter;

so long as the drainage is free, kindly and complete repair may be anticipated without interference. In extensive transverse wounds of the ureter involving more than one-third of the thickness of the tube Van Hook concludes "that stricture by subsequent scar contraction should be anticipated by converting the transverse into a longitudinal wound and introducing longitudinal sutures." The technique is thus described: "Make two longitudinal incisions with small scissors in the ureter beginning at the middle of the wound to be closed. These incisions should be equal in combined length to twice the transverse diameter of the tube. Round off the sharp angles of tissue with the scissors and suture longitudinally with the object of producing a very wide instead of a very contracted lumen."

The second method of dealing directly with wounds of the ureters is by "implantation," of which there are several varieties arising out of the difference in location of the injury. To implant a ureter into an isolated knuckle of bowel is found to be objectionable on the grounds that the operation is in itself too dangerous and the intestine is not aseptic. The certainty with which a kidney may be thus infected by means of the intestinal gases proved an obstacle in attempts which have been made in cases of extroversion of the bladder to dispose of the urine in this manner. In injuries to the pelvic ureter during laparotomy, where the continuity cannot be restored or temporary vaginal implantation effected in the female, or vesical implantation in the male, Van Hook advises that the proximal extremity of the duct should be fastened to the skin at the nearest point to the bladder. In injuries to its upper or lower end, the ureter may be implanted into the pelvis of the kidney or into the bladder respectively.

Dr. Abbe [11] reports a case of ruptured ureter of an unusual kind. It happened in an instance of an exploratory operation on a man, by means of Kraske's operation, for what was supposed to be either an abscess between the bladder and the rectum, or a vesical pouch. During the manipulation a ureter was torn across. The sac proving to be a vesical pouch the ureter was implanted into the bottom of it and secured by sutures, The wound healed and the pouch shrank. Dr. Abbe believed the patient would be permanently cured, as in this way the sac was kept flushed by healthy urine. This may further be regarded as a contribution to the treatment of vesical sacculation or pouching.

It should be stated that a case has recently been published which is at variance with the view that the insertion of a ureter into a viscus is objectionable on the ground that the corresponding kidney is likely to become diseased through contact with septic gases. Chaput [12] re-

cords one successful case, as well as a fatal one, where an unilateral uretero-intestinal anastomosis was established in a case of utero-vaginal fistula. The ureter was exposed by an incision in the left iliac fossa and the peritoneal cavity was opened. The paper contains an interesting summary of the literature of this aspect of the subject, though it does not negative the objections to the practice I have stated.

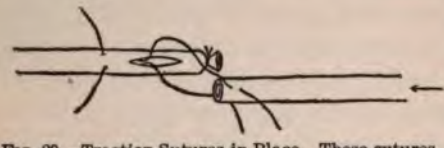

FIG. 29.—Traction Sutures in Place. These sutures pass through the posterior wall of the ureter but once.

In complete transverse division of the ureter in its continuity it seems likely that Van Hook's method of union by what he calls "lateral implantation" will be found of practical value. It consists in ligaturing the free end of the lower portion of the tube about one-eighth of an inch from its divided extremity with silk or catgut; then below this point opening the tube longitudinally to the extent sufficient to receive the corresponding end of the upper portion of the ureter, which is drawn into, and retained in, this position by fine sutures. The mode of effecting this is shown by illustrations (Figs. 29, 30, and 31) in a paper on uretero-ureteral anastomosis by Dr. Howard A. Kelly i the *Annals of Surgery*, January, 1894.

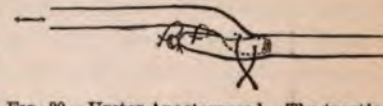

FIG. 30.—Ureter Anastomosed. The traction sutures are hid and the two fixation sutures are in place ready to be tied.

Van Hook thus describes a method of dealing with a wounded ureter of a very ingenious character which was first suggested by Ludwig Rydygier. I am not, however, aware that it has hitherto been successfully practised: "He advises that in cases of injury to the ureter during surgical operations the two ends of the ureter be brought out through the abdominal wall and the wall be allowed to close about them. He would then prepare for the urine an artificial channel of skin by making two parallel incisions between the two openings, suturing together the edges of the isolated piece of skin so as to form a tube, and depressing this tube by sewing over it the severed edges of skin drawn from each side." The changes which take place in the kidney consequent on an impermeable or strictured ureter have already been referred to in connection with the subject of surgical disorders of the kidneys.

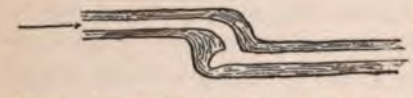

FIG. 31.—Longitudinal Section of the Ureter, Showing New Lumen and Diverticulum.

Obstruction of the Ureters.

I have already discussed how a ureter may be obstructed by a cicatrix following upon a wound as happens so frequently in the analogous case of the male urethra, the effects that may be thus produced in the kidney, and upon what principles the surgeon may proceed in the treatment of such a lesion. I will pass on to notice in what other ways the function of these tubes may be interfered with.

That a fatal result may suddenly be brought about by an obstruction of the ureter there can be no doubt. Dr. Fuller[47] records a case of this kind where a pyonephrotic kidney burst into the abdominal cavity, causing death by acute peritonitis. The ureter was found impacted with renal calculi.

The question has been raised in a paper by Mr. W. G. Nash,[48] based on a preparation of strictured ureter in the Museum of St. Bartholomew's Hospital (No. 2361 A), as to whether such a contraction can be caused by the extension of a gonorrhœal inflammation to these tubes. If it were so, I think that we should meet with instances of this kind more frequently, and consequently that hydronephrosis and pyonephrosis would oftener require surgical relief. Still, having regard to the distance that this specific inflammation sometimes travels, as, for instance, in the female, I should not like entirely to put aside its possibility under the circumstances referred to.

That a stricture of a ureter may be caused by the cicatrix resulting from the ulceration produced by its temporary impaction by a stone, as well as by the scar following the healing of a tuberculous abrasion, there can, I think, be no doubt.

Notwithstanding that operations on the vesical openings of the ureters, either for catheterizing these tubes in the male or for draining them directly, would no doubt be now done through the medium of a supra-pubic opening, the following observations, which I made some years ago on the dead subject, with the assistance of Dr. Barron, may still find a place. Lateral lithotomy was performed on a middle-aged healthy male cadaver; the incision into the bladder was extended in front by opening into the membranous urethra with a probe-pointed bistoury, and behind by cautiously extending the cut into the prostate to almost its extreme boundary. On subsequently removing the parts, it was found that in this way a considerable opening could be made into the bladder without exceeding what I should regard as a safe limit. Though the opening just described permitted a free access to the bladder for the finger, yet no part of the mucous lining of the viscus could be inspected even with the em-

ployment of retractors. With the latter, aided by forcible pressure downward with the hand over the pubes, a small portion of the fundus of the bladder could be brought within sight, but the orifices of the ureters could not be seen, nor could any instrument, such as a probe introduced into the bladder through the wound, be made to enter them. The cavity of the abdomen was then opened by a median incision above the pubes sufficient to permit of the introduction of three fingers over the fundus of the bladder. By thus pressing the bladder down toward the perineal wound, the whole of its mucous surface could be brought into view, including the orifices of the ureters and the trigone. In one subject, by reason of some enlargement of the prostate, the view of the latter was imperfect. With the object of improving this, an endeavor was made to elevate the parts by the introduction of (1) two fingers up the rectum; (2) a lever, (3) the whole hand passed into the rectum. By the first two methods the view of the trigone was not improved, while the hand in the bowel, by occupying the whole space, obscured everything. When, however, there was no enlargement of the prostate, it was found possible, with the hand introduced into the abdomen, to bring all parts of the mucous surface of the bladder into sight, including that immediately behind the pubes. It was found easy to catheterize the left ureter, but the right required a little more looking for. By a bilateral section of the prostate the search for the latter was facilitated, but the conclusion we came to was that with a natural prostate this additional incision was not necessary. It seemed not only possible to bring the whole of the mucous membrane of the bladder into view and within reach of manipulation, and to catheterize the ureters, but, further, with the hand in the abdomen to command all hemorrhage from the parts through which the deeper incision would probably pass. In a case I saw operated on by Mr. Rushton Parker, where the prostate was incised more freely than is usual, a circumstance which probably arose from the form of the calculus, almost the whole of the mucous membrane of the bladder could be readily seen, including the orifices of the ureters, which might have easily been catheterized. The patient was a boy, aged about twelve years, who made a good recovery.

Various means have been adopted for collecting the urine as it escapes from each ureter into the bladder. One of these consists in the employment of ureteral catheters, and another in the compression of one of the tubes and the examination then of what escapes from the opposite kidney. I cannot say that either of them is generally practical. A reference has been made to this means of diagnosis in the section on the surgery of the kidney.

The most frequent form of obstruction in one or both ureters undoubtedly is that produced by the impaction of calculi in their transit from the kidney to the bladder. In cases where the urinary apparatus is normally disposed, apart from the symptoms indicating this, such an occurrence may bring about, when one ureter is involved, the ultimate destruction of the corresponding kidney, or when both tubes are similarly implicated, the speedy death of the individual from what has been called obstructive or mechanical suppression of urine. In cases of the latter the course of events as gathered from records, as well as from some instances I have met with, is usually this:

There is a bygone history of one or more attacks of renal colic, followed, perhaps, by the escape of kidney calculi. The recollection of a paroxysm of nephralgia where no stone was passed may be significant. During one of these occasions, however, a stone becomes impacted in the ureter, and the corresponding kidney is eventually destroyed by absorption or disintegration. In the lapse of time the opposite organ undergoes a compensatory hypertrophy and the entire excretion of urine is thus provided for. So far all this might happen without necessarily exciting much attention; the symptoms of renal colic disappear as the calculus is rendered immobile in the ureter, blood ceases to be found in the urine, and ultimately the fact that the patient has gradually lost a kidney fails to be apparent. In time, however, the enlarged remaining kidney becomes the seat of stone formation as in the former case of the lost organ, and again a renal calculus becomes firmly fixed in its ureter. This of course necessarily means a more or less complete suppression of urine according to the position occupied by the stone in the ureter. The fact may be briefly stated that one kidney has already been destroyed and the other is now blocked mechanically. When the whole history of a case of this nature is reviewed and summed up, there can be but little difficulty in coming to a conclusion as to what has occurred.

Let me illustrate the pathological details of a case of this kind from some well-authenticated source. Sir William Roberts records the following account of the post-mortem findings in a case where an obstructive suppression of urine had proved fatal in the course of nine days and a half:

"*Autopsy:* Strong rigor mortis; body well nourished and quite free from urinous or ammoniacal odor. All the organs healthy except the kidneys and ureters. The *right kidney* was wholly converted into a fibrous mass, studded with cysts, and weighed two and a half ounces. The corresponding ureter was impervious throughout, and changed to a fibrous cord, which was thickened about the middle to

double its width. This thickened part was solid and fibrous like the rest. No stone existed in any part of the ureter or kidney, but it was conjectured that the thickened part of the ureter had been the seat of an obstruction, and that the stone, or whatever object had constituted the obstruction, had been subsequently removed by absorption. The *left kidney* was much enlarged, it weighed ten ounces, and, on section, appeared dark and intensely congested. The ureter was as thick as a goose-quill, and distended with urine. At its lower part were found three little oxalate-of-lime calculi about the size of hemp-seeds, and weighing altogether about one and a half grains. One of these was tightly impacted in the terminal part of the ureter, where it passes through the coats of the bladder; this was the cause of the obstruction. The fluid imprisoned in the ureter amounted to three drachms, and consisted of grumous bloody urine. The pelvis of the kidney was only slightly dilated, and contained about two drachms of bloody urine. The bladder contained about six ounces of pale dilute urine; its coats were healthy."

That cases of this kind and others which might be mentioned should have directed the attention of surgeons to the matter is not surprising. The occurrence of death from a comparatively slight and so removable a cause as I have just illustrated would hardly be likely to pass without comment in these days, when so many of the difficulties connected with exploratory surgery are now removed by anæsthetics and antiseptics. I will proceed to notice the practical aspect of such a reflection, and will do so more by illustration than by generalizing.

As I have already stated, in the normal disposition of the parts the fact that a stone has become impacted in a ureter and is leading up to the absorption or destruction of the corresponding kidney may easily pass by without recognition. Such a case[49] is recorded by Mr. Canton. On the other hand, this circumstance may declare itself by symptoms which in themselves are sufficient to demand surgical interference for their relief without regard to the important issue at stake so far as the future of the kidney is concerned.

What signs then would lead to the belief that one of the two normal ureters is impacted with a stone? Under what circumstances should an attempt be made surgically to effect the removal of the calculus, and lastly, what kinds of procedure may thus be undertaken?

It may be generally stated that a stone may be impacted in any part of a normal ureter; but by reason of its relations the liability to fixation is greatest where the tube enters the bladder. The difficulty of determining whether a calculus has left the kidney and is still retained in the ureter is sometimes great. Usually the symptoms of the latter are less urgent. If, after renal colic limited to one

side and attended with hæmaturia, the pain becomes more fixed, less acute, and pressure with the grasp of the hand refers it to a precise area nearer the groin, while at the same time the presence of blood in the urine either entirely or in a great measure ceases, the probability that the calculus is retained in the ureter is considerable. Relative to hæmaturia, a stone fixed in the ureter will often act the part of a ligature. Of course where one kidney and its ureter are uninvolved in the calculous trouble, the question of suppression cannot arise.

Amongst the more remarkable instances of calculus impacted in the ureter is one I had the opportunity of seeing with Dr. Rawdon, where the stone was felt by the finger in the rectum. The following are notes of the case:

CASE.—T. F., a male, aged six, was admitted into the Liverpool Infirmary for Children on September 20th, 1878, suffering from stone in the bladder. Lateral lithotomy was performed, and portions of a phosphatic calculus were removed. On the twentieth day no urine was passed for six hours and shortly after he complained of pain low down on the left side, which was followed by a rigor. Under chloroform the bladder was explored, but nothing was discovered to account for these symptoms. The rectum was then examined by the finger, when a solid body was felt, which was diagnosed to be a calculus in the left ureter. The patient gradually sank. *Autopsy:* The right kidney was healthy but hypertrophied, being a third over the normal size. The ureter was natural. The left kidney was atrophied, being one-third under normal, though the pelvis and calyces were dilated. The left ureter was dilated and impacted with two calculi. The larger stone which was felt from the rectum during life, resembled a date-stone, and was close above the vesical opening of the ureter.

As with vesical calculi, the continuance of symptoms both distressing and hurtful to the patient and apparently irremediable by medicines would point to the adoption of some exploratory measures which might permit of the removal of the stone if discovered. If the symptoms did not indicate otherwise, I should in the first instance proceed to expose the pelvis of the kidney and the upper portion of the ureter by an incision from the loin, and then, if no stone is detected, to open the pelvis of the kidney, and to explore the whole length of the ureter by the introduction of a ureteral bougie. A long flexible instrument with a slightly bulbous extremity and of about a number 11 or 12, French size, should be used for this purpose. In this way calculi have been removed, or carried on into the bladder, while in other instances, though the latter has not been accomplished, the position of the obstruction has been localized and its subsequent extirpation by a secondary operation, more adapted to the position

of the stone, effected. For an investigation of this kind the use of the electric cystoscope should not be overlooked; it is often quite possible by this apparatus to distinguish between a working and an inoperative ureter whatever the cause of the latter may be. The injection of water into the bladder so as to distend it has also brought about relief to the obstruction, as I have elsewhere stated.[50]

In reference to the latter suggestion it may be thought that the mode in which the ureters enter the bladder is opposed to the possibility of fluid injected into the viscus gaining access to these tubes. This, however, is not invariably the case. In an instance recorded by Mr. Godlee,[51] it is observed, "though the stone was impacted half-way down the ureter the tube was dilated throughout its extent." Doubtless this was due to the passage of previous calculi. Again Dr. Dawson Williams[52] has remarked that "pressure on the bladder caused regurgitation into the ureters and pelvis." I myself have known instances where after a vesical distention and palpation with the hand over the pubes renal calculi were almost immediately expelled.

Among instances of unilateral obstruction of the ureter where the calculus was successfully removed by operation are two narrated by Mr. Cotterell,[53] both of which occurred in females. In the first case it is stated: "Ureter explored by incision similar to that described for tying the common iliac artery. Calculus found impacted just below the brim of the pelvis. The ureter was not sutured." In the second instance it is recorded: "Exploration of bladder by the urethra detected two calculi lodged in lower end of right ureter not projecting into the bladder. They were removed by incising the ureter through the vault of the vagina." Mr. G. Twynam[54] also reports the removal of a stone from the ureter of a child eight years of age by an operation similar to that adopted for tying the common iliac artery. The wound was closed with fine silk. On the fifth day the urine ceased to flow from the wound, and the boy made a good recovery. The stone weighed six grains. Mr. W. Lane[55] records a case where a calculus was removed from the ureter of a woman by abdominal section after a futile attempt had previously been made by a lumbar incision. The abdomen was opened along the left linea semilunaris, and in the portion of the ureter which had not been explored at the earlier operation a small stone was felt. This was forced upward along the ureter to the crest of the ilium, and by means of a small incision the stone was removed. The aperture in the ureter was closed with a fine suture, and healing took place without urine leakage.

Dr. R. Morison[56] relates the particulars of a case in a man aged thirty-one, where a stone was impacted in the ureter about three

inches from the kidney. A lumbar exploration was made and the kidney drawn out on the loin and opened. As no stone was discovered in this position a long probe was passed down the ureter, when the calculus was felt and removed by incision. The ureter was not sutured. Though a troublesome sinus remained some time, recovery was complete.

Mr. Barker[51] relates a case where, after he had removed a stone from the upper part of the ureter, the pain returned by reason of the ureter being strictured from the effects of the stone. That the ureter though contracted was pervious was evident from the injection of milk into it, which escaped by the bladder. The patient was perfectly relieved by having a permanent fistula in the loin. Dr. Cabot[57] also reports two successful cases of uretero-lithotomy, one treated by incision through the loin, and the other, where the stone had previously been felt from the vagina close to the cervix uteri, by an incision through the vault of the vagina. The latter stone weighed 190 grains, and its removal was followed by a gush of pus from above.

Mr. Henry Morris[58] has drawn attention to the feasibility of removing calculi impacted in the lower end of the ureter by perineal urethrotomy in the male, or by dilatation of the urethra in the female, and relates a case where such a proceeding would probably have been successful. After the bladder has been reached with the finger and explored, the use of a scoop is suggested. In some instances where the prostate is very large a supra-pubic exploration might be preferable.

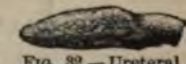

FIG. 32.—Ureteral Calculus.

By the use of the sound and the lithotrite I have dislodged calculi which it is believed were retained in the orifices of the ureters. The figure represents a specimen (Fig. 32) which was spontaneously discharged after I had examined the bladder with a sound. There is a little groove on the side of the stone which prevented the ureter being completely occluded.

Passing to cases of obstructive suppression of urine, where one kidney either is congenitally absent or has been destroyed, possibly almost quiescently, by a calculous occlusion of its ureter, the patient's condition is a very serious one unless the ureter can be rendered permeable, or a renal fistula be established.

There are many suggestive points of interest and practical value in connection with these forms of mechanical suppression. The urine is usually of very low specific gravity and deficient in urea. Sir William Roberts states that when suppression is complete the duration of life appears to range from nine to eleven days. Sir James Paget[59] records a case where there was total suppression for

twenty-one days only interrupted by one day's emission of urine. The late Dr. Moxon referred to an instance where suppression existed for fourteen days, when the patient voided a calculus and recovered. Hence a certain time for action is allowed in cases of this kind so that operative interference need not necessarily be too precipitate. On the other hand, this fact should not be construed as warranting a needless and dangerous delay.

Occasionally the suppression is not absolutely complete, and intermissions when urine is discharged may occur. The latter circumstances are sometimes apt to be misleading, and are probably due to the calculus not fitting the interior of the ureter precisely, or to its being slightly grooved or hollowed out as in the case of a stone which is figured in a preceding paragraph. These urine leakages must not, however, be allowed to distract attention, before it is too late, from the main issue. If the greater bulk of the urine is unable to escape from the body by some channel, uræmic poisoning and death cannot be long postponed. Assisting by medicines and nutriments a partially disabled kidney where the secretion is naturally voided, is a widely different matter from aiding a healthy organ whose excretory duct is as effectually sealed as if it were constricted by a ligature. Such natural reflections as these cannot be allowed to pass by without notice.

In discussing the treatment of this grave condition, the weight of authority obviously leans in the direction of resorting to surgical means for clearing the obstructed ureter after such measures as a reasonable amount of fomenting, massage, and shampooing have failed. The internal administration of cannabis indica has proved of service where there is evidence of ureteral spasm, but pain is not always a feature of this variety of obstruction.

If these means are not speedily effectual the surgeon will do well in not waiting for the improbable to happen, but in proceeding to make a lumbar exploration of the kidney involved. As a rule the latter will be indicated by the history of the case and, as in an instance presently to be referred to, by the comparative degree of fulness presented by the loin. Such an incision will permit of an examination not only of the pelvis of the kidney but also of the upper part of the ureter, localities where stones have been frequently found. If, on the other hand, the obstruction is in the inferior or vesical portion of the ureter, some dilatation may be discovered on incision indicating this, when the pelvis of the kidney should be forthwith opened and the canal explored by means of a ureteral bougie. Failing to dislodge the obstruction in this way a pelvic or ureteral drain in the lumbar region would at all events be established as a temporary ex-

pedient. A channel being thus provided for the discharge of urine, a further search may be made for the obstruction on a future occasion on the lines laid down in my previous remarks on unilateral impacted calculus. In the mean time immediate risk to life would be averted.

In Mr. Lucas' successful case of nephrolithotomy following nephrectomy for total suppression of urine lasting five days, the stone was removed from the pelvis of the kidney. It is described [60] "as of the shape to act as a ball valve to the top of the ureter." The whole of the urine was passed through the drainage tube and lumbar wound for eleven days succeeding the operation, when healing gradually took place.

Dr. W. Hind [61] records a case of total suppression of urine due to an impacted calculus with atrophy of the other kidney from a previous similar condition, which is of much value. It occurred in a man of gouty habits who, though having been more or less under observation for twenty years by various medical men, was never suspected of suffering from any kind of stone. His illness was ushered in by the passage of a renal calculus followed by complete suppression of urine, which continued for six days without the development of any other symptoms. At the expiration of this time the right kidney was exposed by the usual incision from the loin, this side being selected solely from the fact that there was a sensation of greater volume in the right kidney region than the left. The kidney was found to be very large though healthy. At the top of the ureter a hard lump was felt and removed, which proved to be a stone weighing six grains. Higher up in the pelvis of the kidney other stones were felt and were pressed down so as to escape by the incision that had already been made in the ureter. The kidney was then brought down and explored by an incision along its convex border, when a triangular stone weighing thirty-six grains was removed. No sutures were used either for the incisions in the kidney or for those in the ureter. There was little or no bleeding, and the wound was brought together for the greater part by superficial and deep sutures. Twenty-four hours after the operation there was not an unfavorable symptom, and urine was passed abundantly both from the wound and by the bladder. Forty-eight hours after the operation the heart begun to fail and the patient sank, in spite of stimulants, shortly afterward. At the autopsy the left kidney was represented by a mere shell enclosing a mass of calculous deposit weighing 360 grains. In commenting upon the case Dr. Hind observes: "To such an extent were we in the dark as to which side to attack first, that the question of a preliminary abdominal dissection was discussed, but negatived on account of the

weak state of the patient's general health. The rapidity with which the urinary secretion was established after removal of the plugging stone was remarkable."

Another instance is recorded by Dr. Newman[62] where death followed suppression of urine which had existed for five days. At an autopsy symmetrical blocking of both ureters with calculi was found. It is possible that in view of a contingency of this kind in connection with a case of suppression of urine, which did not happen to possess what I may speak of as a previous history, the selection of a laparotomy might seem preferable. There is this, however, to be remembered: that even if such a rare occurrence were seemingly encountered as bilateral and synchronous occlusion, the opening of one ureter or the pelvis of a kidney would at least tide over the pressing emergency, at no great risk, and afford time for any further action to be taken.

Mr. F. W. Kirkham[63] records a case where a man aged fifty-eight had suffered from right renal colic six years previously, when he passed a small calculus. This was followed by a similar attack about a year afterward, when the pain suddenly ceased. On the present occasion the patient was taken with pain running downward from the left loin to the testicle. The pain after lasting for about an hour again suddenly disappeared, and he thought the stone had passed into the bladder. Suppression of urine, however, supervened and continued for over six days. Symptoms of headache and drowsiness with great prostration and muscular twitching setting in, an exploratory operation by a lumbar incision was resolved upon. After carefully exploring the kidney and finding no stone, the exploration was continued downward along the ureter, when a calculus was felt half an inch above where the duct crosses the commencement of the external iliac artery. By an incision the calculus was extracted and proved to be the size of a date-stone. Very little urine escaped from the opening and the hemorrhage was slight. A drainage-tube was introduced and the superficial wound brought together by sutures. Half an hour after the operation an ounce and a half of urine was passed naturally. The wound healed kindly and recovery was complete.

Dr. Ralfe and Mr. Godlee relate[64] a case of suppression lasting fifty-three hours in a woman. The left kidney was first exposed by lumbar incision and a small calculus was removed from the ureter about two inches below the organ. The bladder and the lower ends of the ureters had been previously explored by dilating the urethra with the finger. Large quantities of urine were passed by the wound, but none by the urethra for three days. Subsequently symptoms of

right renal colic developed. Twenty-six days after the first operation the other kidney was explored in a similar way, but only a mass of gravel was found in it. On the day following a small stone was passed by the urethra. The patient recovered.

Dr. R. Morison [56] reports a case of suppression of urine in a man forty-six years of age. The diagnosis arrived at was "that the right ureter was blocked by a calculus, and that the left kidney was for some reason or other *hors de combat*." The urgent symptoms having extended over fourteen days, during which period suppression was almost complete, on the development of signs of uræmic poisoning the right kidney was exposed by the oblique incision in the loin. No stone was found in the kidney, but the pelvis and upper end of the ureter were felt to be considerably dilated. The incision was then prolonged to the centre of Poupart's ligament and the dilated ureter was exposed in the pelvis. One stone about the size of a filbert and another smaller one were discovered firmly impacted in a position thought to be close to the bladder. These were removed through an incision made in the ureter which was sutured with fine catgut. The patient's breathing had become steadily more difficult and altogether ceased just before the completion of the skin suturing.

Necropsy: The amount of fat was enormous. It was evident that the right kidney, its pelvis, and the whole length of the ureter had been explored. The right ureter throughout was as large as a sausage. Within an inch of the bladder there was an opening in it one inch long secured by a catgut suture. The opening into the bladder was free. There were no stones in the ureter, pelvis, or kidney. The kidney was sacculated and much diseased, being in a condition of advanced interstitial nephritis. The left ureter was completely blocked about the middle by a stone. Above and below the obstruction the ureter was dilated. The left kidney was sacculated, and no trace of healthy kidney substance was left. It was evident that this kidney had not been in use for a long time.

I have now, in the first place, endeavored to illustrate various methods by which the surgeon may succeed in relieving the obstruction in cases of unilateral impaction of the ureter by stone. Such a course would be indicated partly by the persistence of pain and the urgency of symptoms and partly by the consideration that, unless mechanical relief is afforded either by nature or art, the destruction of the kidney necessarily ensues. With this knowledge before the practitioner, the character of the non-operative measures to be first employed and their duration must, after what has already been said and illustrated, be left in a large measure to individual discretion.

In reference to the second class of cases, where both ureters are

obstructed and there is more or less complete suppression of urine arising from a mechanical obstruction, the surgeon must not delay making an attempt to free at least one of the ureters until uræmic symptoms are developed. In the absence of direct evidence indicating the precise position of the stone, he will probably do well in taking the lumbar incision as the basis of his operations and making the needful explorations from this position on the lines that have been illustrated. In the entire absence of all local or leading indications an exploratory laparotomy would be expedient.

I have hitherto illustrated some of the more acute forms of unilateral and bilateral ureteral obstruction; there are others to which I will now refer, in the same manner, where though the processes are slower the effects on the kidney involved are equally, though more remotely, disastrous. Some of these can hardly be said to be, at present, within reach of surgery. This, however, by no means implies that they are beyond the limits of our consideration or prospective resources. Some of these conditions are incidentally referred to in a general way in connection with the subjects of pyo- and hydronephrosis.

Dr. W. H. Dickinson [45] records a fatal case where an aneurism of the abdominal aorta which eventually burst into the colon was adherent to the left ureter. It caused symptoms attended with most severe pain which it is stated were in some respects not unlike those of a stone moving in the ureter. The tumor that was thus formed, and described as being the size of an orange, rendered the diagnosis very obscure.

Mr. Barker [46] has brought under notice an instance where in a case of extreme prolapse of the uterus, vagina, and bladder the ureters and renal pelves were dilated. The obstruction was doubtless caused by the alteration in the direction of the ureters as they entered the bladder, as well as by their pressure against the pubic arch. Renal tenderness and reflected pain therefrom may be caused and maintained by the tension exercised by the ureter, as in pelvic growths and in displaced organs. In females particularly, bladder pains may be accounted for in this way and remedied by the removal of the cause, if practical. A vesical pain does not necessarily imply a vesical origin.

Dr. Sainsbury [47] has illustrated a very perfect valve in the ureter which was the probable cause of a pyonephrosis. It occurred in a woman thirty-four years of age. The ureter where it entered the kidney swelled out rather suddenly, and on opening the tube two small flap-like valves were found, on the same level, which effectually prevented all escape from the kidney.

Mr. Shield [67] records a case where a cancer of the bladder obstructed both ureters and produced the usual effects. I have, in the section on surgical diseases of the kidneys, referred to an instance under my own observation where an enormous pelvic hydatid in a man acted in a similar way.

Dr. Tirard [68] describes a rare case of tubercular growth in the ureter in a boy five years of age with a tubercular history who was under treatment for general dropsy. The urine was always faintly acid, free from albumin, and with a specific gravity from 1.010 to 1.020. The left ureter was found constricted by a hard tubercular nodule which would not allow a fine probe to pass without force. The pelvis of the kidney was much dilated. It is stated that no tubercles were to be seen on the mucous surface of the bladder or in the substance of the kidney. The tubercular deposit, therefore, seemed confined to the ureter.

Mr. Targett [69] describes a case of sarcoma in the following words: "The ureter was invaded by a new growth from without which, having reached the interior of the duct, filled and even distended its channel and then spread downward to the bladder." The clinical features were those of an abdominal growth of some months' duration, in a man aged forty-six, the urine containing round and spindle cells and blood clots. The patient died emaciated. In a somewhat similar case [69] the ureter was filled with malignant growth, apparently sarcoma, which had extended upward from a primary source in the bladder.

Dr. S. West [70] records a case where, in a man aged seventy-four, who died from gangrene of the foot, the left ureter was found obliterated by an omentum adherent to the brim of the pelvis. There was a compensatory hypertrophy of the opposite kidney.

An obstructive condition of extremely rare occurrence has been described and illustrated by Mr. Eve and Mr. Bland Sutton [71] under the name of psorospermial cysts. It has also been referred to as mucous cysts of the ureters. The disease, though very exceptional in the human species, is extremely common in rabbits, and appears to be limited to the mucous membrane. Eve refers to a case where the disease occurred in a woman aged fifty-one. She was taken suddenly ill, the prominent symptoms being hæmaturia with exceedingly frequent and painful micturition. Death took place from exhaustion and anæmia seventeen days after the beginning of her illness. The kidneys and bladder were healthy. Microscopic sections made at right angles to the ureter showed cysts of various sizes filled with colloid material, in which were many ovoid bodies corresponding in appearance and size to pseudo-navicellæ.

Dr. W. B. Hadden [67] demonstrated the obstruction of a ureter by a gumma in a man aged fifty-five, who died of strangulated hernia. The kidney and the portion of the ureter above the constriction were dilated. There were other syphilitic gummata in the liver and spleen.

St. George's Hospital Museum contains a specimen where a calculus was found almost filling one of the ureters and measuring five and a half inches in length.

It is under such varied circumstances as are here illustrated that the surgeon may be called upon to devise those measures for mechanical relief which may be necessary in connection with an obstructed ureter. It is only by a comprehensive knowledge of the different conditions under which ureteral obstruction is likely to occur that the practitioner is enabled to recognize those which are probably remediable by the application of his art, as well as to draw his conclusions as to the time and nature of the proceeding to be adopted, according as signs of urgency or danger are developed.

Congenital and Acquired Malformations of the Ureters.

As the integrity of the kidneys is to a large extent dependent on the condition of the ducts by which the urine is conveyed to the bladder, it will be proper to consider other sources of interruption in addition to the stoppages that are occasioned in these tubes by calculi and strictures in the ordinary acceptation of the term. Having referred to this subject already in connection with the conditions just named as well as with hydronephrosis, my remarks will now be confined to certain congenital and acquired malformations of the ureters. It is necessary that the surgeon should have some knowledge of these deviations, otherwise in the case of an exploration he might find himself considerably embarrassed.

It will hardly be requisite to indicate all the congenital varieties that have been met with, after what has been said in my description of the malformations of the kidney. If a person is born with only one kidney it stands to reason that this will probably be represented by a single duct. On the other hand instances are recorded where one kidney has had two or even more ureters, which, as a rule, have coalesced into one tube before entering the bladder. Sir William Roberts gives an instance where the ureters crossed on their way to the bladder. In what are called horseshoe kidneys, where the two organs are united by a transverse bar, either at their base or at their apex, there are usually two ureters which descend in front of the connecting link. According to Dr. Wilks there are exceptions to this, the ducts descending occasionally behind the bridge. Sir Henry

Thompson[72] saw a kidney with two ducts which united into a single ureter about an inch below their necks. Mr. J. Wood,[73] on the other hand, has described an instance where the union did not take place until about an inch from the bladder.

Reference has already been made to the great dilatation the ureters sometimes undergo. These tubes have been found to resemble in size a portion of the small intestine. When produced by distal causes, as for instance prostatic obstruction or urethral stricture, by containing urine and undergoing inflammation they add materially to the gravity of the case. Where the obstruction in front of the bladder is so great as to induce this and to threaten, by its persistence and resistance to all ordinary treatment, extension of the inflammation to the kidneys and their dilatation and eventual disintegration, the surgeon is justified in entertaining measures which will permit of a free and incontinent escape of urine from the bladder. The adoption of some form of bladder drainage under these circumstances is often to be recommended. The technique of this proceeding, which is one that does not entail additional risk so far as the operation is concerned, is fully described in my article on diseases of the bladder. That the consequences of obstruction in front are extending to the ureters and are commencing to influence the kidneys may be inferred by various circumstances which gradually develop in connection with some of the worst forms of prostatic and urethral obstruction. More especially are they to be observed in association with that variety of dense and contractile strictures which results from wounds and laceration of the male urethra.

The mode in which dilatation of one or both ureters is usually brought about is through the expulsive pressure of a normally disposed or an hypertrophied bladder upon its contents, much in the same way that pressure with the hand on a rubber ball syringe, unprotected by valves, has a tendency to drive its contents into both the afferent and the efferent tubes with which it is connected. In this way in a case of urethral stricture dilatation of the ureters as well as of the urethra on the proximal side of the obstruction is gradually brought about.

There are, however, examples where the process is somewhat different; excluding cases where the ureters are dilated by what descends, as, for instance, the frequent passage of renal calculi, of pus, and of other fluid and semi-solid contents of the kidneys in the course of disease, there are others which do not admit of explanation in these ways. Specimens are occasionally met with in young persons where the ureters are enormously dilated and yet no mechanical explanation of this can be found in the bladder or its contents, or in

any portion of the urethra, prostatic hypertrophy being, of course, out of the question. In a case reported and commented on by Dr. Dawson Williams [52] in a boy five and a half years of age, no other conclusion could be arrived at than that the dilatation of both ureters and kidneys was probably of congenital origin, an assumption which Mr. Targett has also offered in explanation of some forms of sacculation of the bladder. That frequent spasm of the bladder is sometimes a cause of dilatation above I can have no doubt. I have seen this on several occasions in both sexes in cases of tubercular ulceration limited to the bladder, where the latter, though of small capacity, was kept in an almost constant state of contraction.

As I have urged that in the ordinary forms of ascending ureteral and renal dilatation and disintegration, observed in connection with serious kinds of obstructive disease lower down, other measures failing, free and incontinent urine drainage should be established, I will proceed to notice some indications relative to the incidence of these serious and very fatal complications.

In the first place it must be remembered that they are the outcome and natural termination of the most serious forms of prostatic and urethral obstruction. I have seen many cases of traumatic stricture ending in this way and in death from uræmia by reason of the almost entire absorption of kidney tissue. Sufficient stress, however, has already been laid upon this point.

The probability that these ascending changes are advancing is frequently indicated by certain abdominal expressions which, taken in connection with the nature of the obstruction, cannot be otherwise than highly suggestive. Where the ureters have been very large I have distinctly been able to make out by deep pressure with the hand bilateral vertical prominences in the direction of the kidneys in contradistinction to the feel that ordinary intestine affords to the touch. Lines of perpendicular sensitiveness can thus often be made out. Though tenderness over the kidneys can generally be discovered if looked for, perceptible fulness or swelling is rarely made out until these organs have become seriously involved. Sensitiveness on pressure over the kidneys in both prostatic and urethral obstruction is often significant.

In this aspect of obstructive disorders below the bladder thermometric observations are often of much value. A dilated ureter is a tube that is rarely empty. Small quantities of urine collect in dependencies within it, and local inflammation is excited, and this is often indicated by irregular temperatures. I have made many observations of this kind in connection with chronic prostatic and stricture cases where the ureters and kidneys have eventually proved to be both

dilated and inflamed. It is quite a different temperature chart to that which is seen in the ordinary forms of urethral fever following the use of instruments. In the former case the variations are more like those which occur in what we used to speak of as hectic fever. Then again there is often thirst and a dry tongue, and the patient is generally materially relieved by flushing the kidneys with some bland antiseptic fluid. There is difficulty in doing this when the obstacles in the way of expelling urine from the bladder are considerable. On the other hand, when bladder drainage has had to be provided to secure incontinent and free expulsion of the urine from the bladder, independently of the will, a diuresis of this kind is often most beneficial.

Then in the last place the urine of back-pressure and supra-vesical dilatation may be suggestive. It is often purulent, with a faintly acid reaction when recently passed, and with a low specific gravity. It is to this class of cases irrespective of age that Sir James Paget's[4] remark is appropriate: "Let me tell you of a symptom which must make you specially cautious if you have to catheterize elderly or old men. If they are passing large quantities of pale urine of a very low specific gravity, whether containing a trace of albumin or not, they will be in danger from even the most gentle catheterism. For this condition of the urine is often due to some advanced defect of action in the kidneys, and a catheterism will be followed by inflammation of the bladder and the so-called urinary fever, and death will hardly be escaped."

The urine that is secreted under a high pressure, as where obstruction, though not complete, is considerable, is described by Sir William Roberts as "very pale, watery, devoid of its proper coloring matter, poor in urea, and of low specific gravity. It may indeed be tinged with blood, but this is an accidental circumstance." I have frequently seen urine which for some time had presented these characteristics in some advanced forms of traumatic urethral stricture where dilatation of the ureters and kidneys was probably going on, immediately assume more healthy characteristics after all tension has been taken off by a suitable bladder drainage being provided. By these means the excretion may be observed to return gradually to a normal standard, with permanent advantage to the patient. This is an expedient which must not be lost sight of in connection with the mechanical treatment of these progressive dilatations.

Instances are recorded where dilated ureters appear to have served the purpose of subsidiary bladders. Here it is probable that the obstructions were not progressive, and though urine might have been retained in these dilated tubes the flow through them was sufficiently

free to prevent any decomposition of the excretion taking place. Cases of this kind with observations have been published by Hutinel[75] and others.

Some malformations and displacements of the ureters which have required surgical interference may be noticed here. Dr. F. H. Davenport[76] records a case of incontinence of urine due to malposition of a ureter. The patient was a female, aged twenty-nine, the mother of three children, who had suffered from incontinence of urine all her life. This was found to be due to "a malformation of the ureter, which, instead of turning into the bladder at its normal place, was continued along the septum between the bladder and vagina and emptied by a special opening near the meatus." Dr. Baker[77] appears also to have described and subsequently operated upon a similar case. Dr. Davenport states "the indication in his case was, if possible, to dissect up the ureter from its bed in the anterior vaginal wall to a point corresponding to where it could normally enter the bladder, make an opening into the bladder, turn the ureter in and fasten it there, and then close the fistula." This appears to have been satisfactorily accomplished.

Mr. Davies-Colley[78] furnishes the particulars of a case he treated for protrusion of the orifice of a ureter through the meatus urinarius in a female child. Examination with the finger and a probe showed that the protrusion came from the left side of the bladder. The mass was ligatured in two halves so as not to obstruct the ureter, and was then cut off. For a few days the patient seemed relieved, but gradually sank. The protrusion was confined to the mucous membrane surrounding the opening of the ureter and did not involve any other portion of the tube. Caillé[79] reports a very similar case.

Ureteral Fistulæ.

These have been referred to incidentally in connection with wounds of the ureters and the surgery of the kidney, and do not require any special consideration. It may be of interest to recall that the kidney was first, it is believed, successfully removed for a lesion of this nature by Simon of Heidelberg. It is hoped that the necessity for such a proceeding may be rendered less frequent by the substitution of those plastic attempts to restore the continuity of the tubes which have been noticed in the course of this article.

In thus presenting the surgery of the ureters in a somewhat systematic form, I have endeavored to collect facts bearing upon the integral parts of it, rather than to draw conclusions which would hardly be warranted in a subject of so comparatively recent develop-

ment—much that is here described and illustrated must necessarily be submitted to the test of a more extended experience, which is now gradually but surely forthcoming.

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DISEASES OF THE BLADDER.

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DISEASES OF THE BLADDER.

RUPTURE AND INJURIES OF THE BLADDER.

RUPTURE or bursting of the bladder may be caused by violence applied directly over it when it is in a more or less distended condition; by penetration from within, as by the sharp ends of fractured bones, or from without, by bullets and other missiles. It has been known to give way under artificial distention for surgical purposes, and it is also believed to have been ruptured by muscular contraction.[1] It has been occasionally opened accidentally in the course of surgical operations involving parts in its immediate contiguity.

There are certain general considerations to which reference may first be made before proceeding to notice the varieties the injury presents in view of their treatment. In many cases of rupture of the bladder there can be no doubt that a weakened state of its walls, due to long standing disease, has contributed in no small measure to this result. This circumstance is important to remember where we have to employ distention of the bladder for surgical purposes, as, for instance, in supra-pubic cystotomy, where the resistance of the coats of the viscus is occasionally submitted to a somewhat severe test. In relation to contributing causes of rupture of the bladder, Mr. W. H. Bennett[2] has reported a case where the puncture made by an aspirator needle preceded this event. In the next place stress may be laid upon the importance of making an early diagnosis in all instances of this kind, for, if the rupture is to be closed with any chance of success, no time should be lost. Hence, it is a good rule in cases of pelvic injury, or even of suspicion that such may have occurred, to make careful investigations as to the state of the bladder, and if necessary to take the precaution of using the catheter. If a direction of this kind can be regarded as applying to conscious patients, it does so with still greater force to those who, for some reason or other, are not in possession of their faculties. In more than one instance that has come to my knowledge it was discovered after death that the insensibility of alcohol or poison led to a lesion of this kind having been overlooked. Though in none of the cases I can now recall was the rup-

tured bladder the immediate cause of death, the fact that it complicated other still more serious conditions must not be forgotten. Further, as cases of this kind not unfrequently occur in connection with matters requiring medico-legal investigation, such as in fighting, sparring, wrestling, and in modern football, difficulties sometimes arise in getting at the facts, for which allowance should be made. In hospital practice it has happened that this lesion has not been recognized, because not suspected, and thus complaints have arisen in consequence of patients having been allowed to go to their homes and to remain there until symptoms developed. Subsequent autopsy, in some of the cases, has shown the difficulties connected with diagnosis to have been well-nigh insuperable.

Ruptures of the bladder are of two kinds—intra-peritoneal and extra-peritoneal. In the former the area of the abdomen, as defined by the peritoneum, is opened into, and urine usually enters it; while in the latter, if urine escapes, it is in the form of an infiltration around the parts constituting what is called the neck of the bladder, where it produces effects such as are observed in more superficial parts in connection with extravasation of urine.

In the case of an injury applied over the region of the bladder, how are we to ascertain that this organ is ruptured, and if so, whether the rupture involves the cavity of the abdomen? Having determined these two points, what are the lines of treatment? These three aspects will now be considered. In addition to the history of the injury and its locality, such a lesion is usually attended with considerable shock. If the urine has suddenly escaped into the peritoneal space, this collapse may be spoken of as profound, and peritonitis generally follows with much acuteness. Then we have the fact that the catheter usually draws off only a small quantity of blood-stained urine, and possibly it may at the same time be noted that the instrument passes quite easily up to the hilt, giving the impression that it must have entered the abdominal cavity, which is often the case. Upon the latter point there is, however, some variation. Though there may be a rent directly communicating with the peritoneal cavity, the end of the catheter may not happen to pass through it, and then a sensation of contraction is experienced such as almost to lead the surgeon to believe that the instrument has not taken the natural course. Examination, however, by the finger in the rectum generally serves to indicate that the instrument is in its right position, but is firmly grasped by the contracted viscus.

Case.—In a case of extra-peritoneal rupture of the bladder, which was inflicted by a man falling, while wrestling, and striking his prostrate opponent with his knee just above the pubes, there was the sen-

sation of contraction experienceed in introducing a metal catheter, but this was due to the catheter having made its way through the rent in the anterior wall of the bladder immediately above the prostate, which was also involved in the injury. A post-mortem examination showed that the instrument had passed through the rupture and had entered the *porta vesicæ* of Retzius. Death was caused by cellulitis, due to deep urinary extravasation. Had a drainage-tube been carried through the rent from a suprapubic incision into the *porta vesicæ* and out by a perineal opening, I believe the man's life might have been saved, as the case really resolved itself into one of urine drainage.

If the catheter does not indicate with clearness that the cavity of the peritonæum is opened, the distention test should be tried, as described by Dr. R. F. Weir,[3] who, after stating the injuries and the symptoms of a case, remarks: "Only two procedures seemed available, therefore, viz., digital exploration by a perineal incision, or by opening into the abdominal cavity. Rather than resort to either of these I thought of using the test of distention of the bladder as employed in the supra-pubic opening for calculus, tumors, etc. Accordingly, two hours later, the abdominal tenderness having increased, the patient was etherized, and a rubber catheter first inserted into the bladder, and then Peterson's rubber bag passed into the rectum and distended with seven and a half ounces of warm water. After this had been done, and the line of supra-pubic flatness, now slightly augmented, outlined by a colored pencil, seven and a half ounces of carbolic acid solution—1 to 100—were slowly introduced into the bladder. When six ounces had been passed in, the contour of the bladder could be felt above the line of blood extravasation, and the additional quantity of fluid served only to make this more positive, especially so on the lateral aspect of the distended viscus. The injected fluid was then allowed to flow from the bladder and measured, and found to correspond with the quantity forced in. The demonstration was perfect, not only as to the impossibility of an intra-peritoneal, but also, from the non-increase in the line of dulness over the pubes, as to an extra-peritoneal laceration. The rectal bag was thereupon emptied and withdrawn, and the patient saved from any surgical interference of a more heroic character."

The diagnosis of intra-peritoneal rupture having been made, laparotomy should be undertaken. In connection with this proceeding we are indebted to Sir William MacCormac for the first successful records of closure of the ruptured bladder by suture. Without going into the details of the two cases he has published, stress may be laid on some points which are of importance. It does not appear to have been necessary to pare the edges of the wound in the bladder, though

great pains were taken, by careful approximation of the sutures, to make the bladder water-tight, and thus to prevent leakage. Carbolized silk sutures were used, and they were introduced as shown in Fig. 33. In reference to the use of a catheter, as well as of drainage of the abdomen, Sir William remarks:[4] "If the rent be sutured effectively, the patient runs less risk from moderate distention of the bladder, which is all that can possibly occur in a case properly watched, than he does from the consequences of retaining a catheter for some days within the viscus. The experience of my two cases goes far to prove that the catheter may in many instances be safely dispensed with altogether. I am sure, too, an abdominal drainage-tube is not in most cases needful, and that its presence proves a source of danger to the patient."

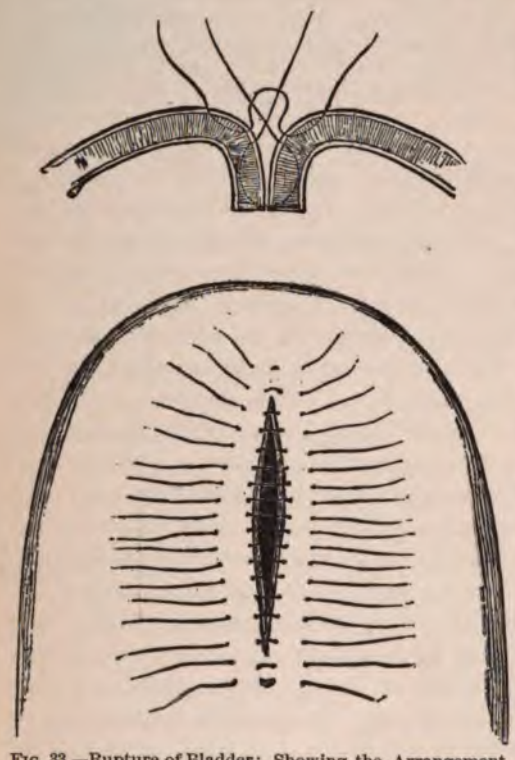


FIG. 33.—Rupture of Bladder; Showing the Arrangement of Sutures. The upper figure is the same in cross-section. Schematic.

Though there can be no doubt that laparotomy and suture of the ruptured bladder is the safest course to be pursued in cases of this nature, the question may be raised as to whether, under any other circumstances, repair has been known to take place. In reference to this point, the following case, recorded by Mr. Henry Morris,[5] is of interest:

CASE.—The patient was received at the Middlesex Hospital in 1879, and treated for a rupture of the bladder consequent upon violence. The treatment consisted of fomentations, opium, and the retention, just within the neck of the bladder, of a gum-elastic catheter. He recovered perfectly. In 1886 he was again admitted into the Middlesex Hospital, and died shortly afterward of rupture of the bladder. The parts removed were submitted to a committee who reported "the specimen exhibits all the features which might be expected at a remote period after rupture of the bladder." Mr. Morris remarks:

"This case was reported in 1879 as one of recovery from rupture of the bladder. It is now brought before the Society because in its completed form it affords conclusive proof that an intra-peritoneal rupture of the bladder is not necessarily fatal, but may be recovered from under the simple treatment employed in this case, provided the urine at the time of the rupture is of normal composition."

Such an inference as Mr. Morris's case suggests is warrantable from other circumstances observed in connection with certain appearances presented after death in some instances of intra-peritoneal rupture of the bladder, in conjunction with clinical experience relative to the drainage of urine from within the area of the pelvis. The contraction of the bladder after it has been ruptured and its contents expelled into the peritoneal cavity, as noted particularly by Mr. Rivington in his excellent treatise on this subject, is so great as to render it highly probable that if a free and involuntary exit for the urine were provided within a reasonable period after the receipt of this injury, nature would be able to effect the rest and bring about recovery without the adoption of other means. So far as my experience goes in connection with the various ways of opening the bladder, in all of which I may say I have had some experience, the only one that can be trusted for such a purpose is the incision made for lateral lithotomy, as combining in the one method free, involuntary, and dependent escape of the urine as it emerges from the ureters. On several occasions I have had to put my finger into the bladder, through the wound, within a few days after a lateral lithotomy has been performed, and I have been struck with the firm contraction of the viscus with which this procedure was invariably met. The following case seems to support this, and shows, where circumstances were propitious, how nearly the imperfect drainage afforded by catheterism was successful:

Case.—At the time of the accident, which was caused by the patient's adversary falling upon him during a pugilistic encounter, a sensation of something having given way was experienced. He walked home, a distance of two miles, when he was seen by his medical attendant, who drew off twenty ounces of bloody urine, and continued to do so twice a day for three days, until he was admitted into the Leicester Infirmary under the case of Mr. Crossley. On his admission, November 20th, 1872, he presented the following signs: He was able to walk without assistance; countenance rather anxious; pulse 80, full; skin cold; complained of a sensation of weight in the hypogastric region, but no tenderness on pressure. On percussion over the abdomen an increased area of dulness was detected, and on palpation a distinct sensation of fluctuation. A silver catheter was introduced, and thirty ounces of clear urine drawn off, the abdominal dulness and fluctuation entirely disappearing. A gum-elastic catheter was subse-

quently passed night and morning. The patient continued in much the same state up to the evening of December 1st, when, without any premonitory symptoms, he was seized with a severe attack of convulsions, rapidly followed by coma. Every effort was made to rouse him; a catheter was immediately introduced, and about twenty ounces of urine drawn off, consciousness returning in about an hour. On the following day he was again attacked in a similar way, and on December 3d he was seized with a more violent form of convulsions, and sank in three hours in a comatose state.

Post-Mortem Examination.—On opening the peritoneal cavity, about four pints of clear fluid welled up through the incision. The bladder was found contracted and a laceration of its posterior surface to the length of two inches was detected extending in an oblique direction. In other respects the organs presented no morbid changes.

This case presents the following points of interest: First, the power of locomotion after so serious an accident, the patient having walked to his home, a distance of two miles, immediately after the occurrence. Secondly, the length of time he survived—sixteen clear days—the average duration of life in these cases being from three to seven days. Thirdly, the absence of all signs of peritonitis. Fourthly, could the death of the patient be attributed to peritoneal absorption?

In view of what has been effected by laparotomy and suture in cases of intra-peritoneal rupture of the bladder, no other treatment can be recommended, unless for some reason or other it is found impossible to give effect to it.

The diagnosis of extra-peritoneal rupture of the bladder is somewhat facilitated by excluding, in the way referred to, the likelihood of the other variety. If the use of the catheter, in conjunction with the history of the case, and examination by the rectum are insufficient to indicate this, in the presence of a lesion evidently involving the mechanism of micturition, a perineal puncture into the membranous urethra for the digital exploration of the neck of the bladder should be proceeded with. Many patients in cases of this kind have undoubtedly been lost for the want of that knowledge which can only be thus obtained. Where the suspicion is grave, the possibility of not finding such a lesion by exploring should not be allowed to weigh against making the attempt. If a pelvic fracture, with rupture of the viscus, or rupture alone, is discovered, a drainage-tube should be inserted in the bladder. If the prevesical space is also opened, an additional aperture above the pubes will be required, in order that through drainage may be provided. Procedures of this kind are safe and slight compared with the risk connected with extravasation of urine imperceptibly going on in a part where otherwise drainage is impossible and subsequent absorption certain. This point is illus-

trated in the following case which I saw, with Dr. C. G. Walker, at the Bootle Hospital in 1882:

CASE.—The patient, aged 40, a fireman on board a steamer, was brought into hospital with the history that on the preceding day the surgeon of the ship was summoned to him in consequence of his inability to pass urine and of pain above the pubes. It was thought that he had been drinking, and might have hurt himself when stoking coals. The catheter was passed, and about two pints of blood-stained urine drawn off. On admission the abdomen was distended, with an area of dulness on percussion and tenderness above the pubes; the perinæum was ecchymosed, and he was collapsed. After the diagnosis of rupture of the bladder had been made, the treatment consisted in the retention of a rubber catheter and irrigation of the bladder with a weak carbolic lotion. An erythematous rash, suggestive of extravasation, began to appear over the right iliac region, extending half-way down the thigh. Vomiting and prostration set in, and the patient died on the fourth day after the presumed injury. At the autopsy a cavity about the size of an orange, filled with blood-clots, was found behind the pubes. There was a rupture two inches in length in the anterior wall of the bladder where it is uncovered by peritonæum, the urethra being normal. Though there was no history of injury, there could be no doubt that the lesion was due to a blow above the pubes over a full bladder.

The following case, recorded by Dr. Weir,[1] illustrates the practice that is to be recommended in cases of this description:

CASE.—"It was one of injury to the pelvis and left hip of a man, aged 28, by a fall of earth. A catheter was passed on his admission to the New York Hospital on November 20th, 1883, a short time after the accident, which gave exit to a moderate amount of bloody urine. The injury was regarded as a slight urethral laceration, but the marked increase in the supra-pubic dulness, which now extended four inches above the pubes and across into each groin, with tenderness, led to a closer examination of the patient. The catheter passed readily into the bladder and only occasionally gave exit to blood-stained urine. The urine itself was passed at times voluntarily, and was not apparently diminished in amount. The temperature was but 99°. Abdomen not distended, though its walls above the dulness were somewhat rigid. Condition still good. No signs of fracture elicited, but the finger in the rectum detected a softer spot on the left side of the prostate, which was decidedly painful. The ecchymosis of the scrotum and perineum was now very pronounced.

"November 24th. The temperature had risen to above 100°, pulse 104, and patient began to be restless and disposed to vomit. Tympanites increasing, with abdominal tenderness not only above the line of dulness but below it. A large hypodermic needle inserted in the hypogastrium drew out some bloody fluid with an acid reaction and urinous odor. Nothing distinctive could be felt in the rectum. The patient was etherized and an incision, under sublimate irrigation (1 to 1,000), was made, three and one-half inches long in the median

line, midway between the symphysis and umbilicus, until the subperitoneal cellular plane was reached, where a large cavity, containing at least a pint of bloody, undecomposed urine, was found. The finger could be carried its full length behind the symphysis, but nothing could be detected. To effect a more complete diagnosis, as well as to allow of the carrying, if possible, of a drainage-tube from the hypogastric opening down and out of the perineum, the patient was placed in the lithotomy position, and on a staff introduced into the bladder a median incision was made, opening the urethra just anterior to the prostate. The finger passed in here toward the bladder revealed a rent running along the left side of the roof of the prostate which was lost in the wall of the bladder itself. Through the suprapubic incision a large silver catheter was carried, and, aided by the finger in the perineal wound, was caused to pass through the laceration of the bladder and to emerge from the lower wound. To the eye of this catheter a thread was attached, and a large rubber drainage-tube pulled through as the silver instrument was withdrawn. Each end of the tube was secured by a suture to the skin, and a second drainage-tube was then passed into the bladder, and its external end also fastened in the perineum. The cavity of the extravasation and the bladder were carefully washed out with a warm sublimate solution of 1 to 2,000, and iodoform gauze was placed over each wound, though so lightly that urine could readily flow through the dressing. The progress of the case was in every way most satisfactory, the patient making a complete recovery, and leaving the hospital on December 24th."

Penetration of the bladder by sharp instruments, or by bullets and other projectiles, is occasionally met with in civil as well as in military practice. An unusual instance of this kind is recorded by Mr. Couper.[8]

CASE.—A seaman, aged 23, was admitted into the London Hospital on April 26th, with a small incised wound of the left buttock. He had been stabbed in a quarrel, with a sailor's long knife. He walked into the receiving room, but with difficulty; was blanched, and in a condition approaching collapse. From the state of his clothing it was evident that he had lost a great deal of blood. The wound was about one inch long, was clean cut, and situated exactly in the middle of the left buttock. The finger introduced into the wound passed for some depth in the direction of the great sciatic notch, which could be felt. Shortly after admission he passed his water; it was clear, and contained no blood. Next day, the patient appeared quite comfortable, and had no difficulty with his water, which was passed at usual intervals and was normal. April 28th. Patient vomited several times; complained of pain over abdomen; became restless. Temperature at night 104°. Symptoms of acute peritonitis now became more apparent, and death took place on May 1st. Throughout he never had trouble with his bladder.

At the post-mortem examination the knife was found to have taken the following course: It had penetrated the gluteal muscles, divided

a part of the great sacro-sciatic ligament, and passed through the small sacro-sciatic notch, completely dividing the pudic artery and nerve and one vein. Each end of the artery was perfectly closed by a little clot. The knife had then entered the bladder at its lower part, and close to the trigone, making a wound large enough to admit the tip of the forefinger. There was diffuse suppuration of the cellular tissue of the pelvis and general acute peritonitis.

The case is interesting as illustrating the complication which, from the symptoms, there were no grounds for suspecting, post-mortem examination alone revealing it.

In cases of incised wounds, where there is a suspicion of evidence that the bladder is wounded, it is probably better to allow the urine to drain off by a catheter, passed either through the wound or along the urethra, whichever way the urine flows the more freely, rather than permit of it being voluntarily discharged by the bladder. In wounds of the anterior wall of the bladder, the experience of suprapubic incisions made for surgical purposes, and suicidally, seems to indicate that the best plan is to leave the wound to granulate, provided the urethra is not strictured. In the latter case, perineal puncture for drainage, with division of the contraction, might be required.

Sir William Stokes[9] records the particulars of a remarkable case where one of the long handles of a pair of iron tongs, over which a boy was vaulting, entered the rectum and passed through the bladder into the peritoneal cavity. The viscus was consequently ruptured in two places. Death followed in seventy-four hours from peritonitis.

Gunshot wounds involving the bladder, though requiring treatment on general principles, belong to a branch of surgery of which, as civilians, we see but little. Every variety of this kind will be found illustrated in a work which modern warfare[10] has provided us with. A foreign body which has found its way directly into the bladder, or indirectly by ulceration or sloughing, may serve as a nucleus for the formation of stone; of this we have instances, in the work referred to, of concretions forming on arrow-heads, as used by the Indians, on bullets and other projectiles, on pieces of bone, or on the *débris* of a fractured pelvis which have found their way into the bladder. Portions of clothing, buttons, and other articles of dress, have also become covered with phosphatic concretions. In all cases of gunshot injuries involving the urinary apparatus care should be taken, either by catheterism or incision, to provide for escape of the urine, as its collection in the locality of extravasated blood or damaged tissue is a certain cause of destructive inflammation. We should also not neglect to ascertain by the use of a sound if any foreign body is lodged in the bladder.

It is asserted that rupture of the bladder may occur without extravasation of urine ensuing as a consequence. I do not see what positive evidence of this can be afforded; the nature of the injury and hæmaturia may possibly suggest it, but this is about all that can be said. If it were suspected that a slight rupture had taken place, which by some means or other—such, for instance, as the presence of a clot in the wound, its valvular form, or the exudation of inflammatory material—had become occluded, I should not feel disposed either to pass a catheter, provided there was no retention, or to retain one. I would sooner trust to Nature completing a task she had commenced so well, aiding her, perhaps, in keeping the parts quiet and the skin active by the internal administration of opium.

The power of a patient voluntarily to expel his urine is occasionally temporarily suspended in connection with injuries to the trunk. Retention of urine not unfrequently follows concussion of the spine. Power usually returns in the course of forty-eight hours, and, so far as this symptom is concerned, nothing further than regular catheterism is required. In courts of law imperfect power in micturition is sometimes referred to as a symptom of spinal concussion. When it immediately follows an injury and disappears, it need not create apprehension, as it is only in keeping with the other signs of nerve shock. If it occurs after a lapse of time, and is consequent upon an injury, its import is grave, as it is probably connected with structural changes in the nerve centre controlling the action of the bladder. Retention of urine happens in connection with violent contusions, such as crushes involving the abdominal muscles. The inability of the latter to co-operate with the bladder in the expulsion of urine, without causing pain, is sufficient to explain this, and does not require any special treatment beyond the use of the catheter until normal function returns.

FOREIGN BODIES IN THE BLADDER.

By accident or design foreign bodies occasionally become lodged within the bladder. Among the miscellaneous articles that have been found in this position I can recall to mind pins, needles, wires, a lucifer match, a knitting-needle, a slate pencil, a feather, a bulb-headed grass, pieces of catheters and bougies, a whole bougie, and a pencil-case; but, taking the experience of others, this list might be considerably extended. Most of these things have been introduced for the purpose of acting upon the penile portion of the urethra—for reasons best known to the patients themselves—and have subsequently made their way into the bladder. In reference to the movements of

foreign bodies, my impression is that the vermicular action of the urethra is an ejaculatory one, and that such a body is only forced toward the bladder when in its form it presents an obstacle to its outward passage. A piece of bougie, with its anterior extremity broken and uneven, and its posterior end smooth, placed in the urethra, is sure by the vermicular action of the canal to be forced in a direction toward the bladder by the effects that are made to expel it. I will mention some cases where foreign bodies have been passed into the urethra, as serving to illustrate certain points in practice.

CASE.—In 1861, I saw a youth, aged 16, who was suffering from some induration in the ischio-rectal fossa and perinæum. On inquiring into his history, it was found that eighteen months previously the patient had passed into his urethra a needle, which, having slipped from his grasp, disappeared. Not liking to mention it, he refrained from seeking surgical advice. He appears to have suffered very little inconvenience up to within a week from his being seen, when he had pain about the perinæum and difficulty in micturition. As fluctuation could be felt in the ischio-rectal fossa, an incision was made, and some matter evacuated, but no needle was discovered until the finger was passed into the rectum, when the sharp point presented in front. A median perineal opening was made and the foreign body removed. It was largely encrusted with a deposit of phosphates. The patient recovered rapidly, no urine escaping through either of the incisions.

Mr. Mitchell Banks has given me the particulars of a case he had seen where a needle had been passed up the urethra by a boy three days previously. On examining by the rectum he could feel the blunt end of the foreign body, and was able to force the point through the perinæum and thus to extract it. In the following instance I removed from the bladder of a middle-aged man a bougie, twelve inches in length:

CASE.—The bougie had been introduced by a surgeon as a guide to a urethrotome, with which it was intended to divide a stricture by internal section. Unfortunately the bougie separated from the urethrotome just beyond the point where it was attached by means of a screw. The surgeon at once divulsed the stricture by Holt's method, and left the bougie in the bladder for extraction on a future occasion. I saw the case fourteen days after the accident. As the urethra would by this time admit a No. 12 bougie, I had no difficulty in introducing the lithotrite and extracting the bougie, which I seized about the centre and brought out doubled; it being soft and of small size, the removal was accomplished by merely gentle traction. The patient recovered without a bad symptom. The bougie appears to have remained curled up in the bladder; no calculous deposit was observed upon it, although it had been retained for a fortnight.

It is possible that the extraction of long bodies offering greater resistance, such as thicker catheters and bougies, might be facilitated

by first dividing them with Caudemont's cutting lithotrite, and then extracting them in portions. The case just narrated points to the necessity of care being exercised in properly securing the connecting links between urethral instruments and the guides now so frequently used in connection with them.

Among the more remarkable objects that have found their way into the bladder is a bulbous grass, as in the following case:

CASE.—A middle-aged man came into the Liverpool Infirmary in 1865, under the care of Mr. Long. The patient supposed he was suffering from stricture, to remedy which he was in the habit of passing different materials into his urethra. On this occasion he selected the ear and stalk of one of the grasses, which was introduced readily enough, but could not be withdrawn. When admitted shortly after the accident, he was suffering from most acute cystitis. A lithotrite removed a portion of the grass-head, slightly encrusted with phosphates, but the symptoms were not abated, and death resulted. On opening the abdomen general peritonitis was found, with four or five pints of turbid serum, which exhaled an ammoniacal odor. The bladder contained (Fig. 34) a head of one of the grasses, covered with phosphatic deposit. The stalk, which was stiff and resisting, had made its way through the fundus of the bladder, and protruded into the peritoneal cavity. The pelvic cellular tissue was infiltrated with purulent matter, having a urinous odor, and the inflammation extended up the ureters to the kidneys. The history of the case was obtained at first not without difficulty, and what had actually been inserted into the urethra was a matter for speculation, which the introduction of the lithotrite only incompletely determined.

FIG. 34.—Bladder Containing a Head of Grass.

The following case, analogous with the preceding, illustrates the value of the electric cystoscope where foreign bodies of a soft nature are passed into the bladder, and cannot be felt with any instrument:

CASE.—A middle-aged man applied at St. Peter's Hospital in 1892, stating that he had put a piece of grass up his urethra a week previously, and believed it was now lodged in his bladder. I passed a sound, but feeling nothing, endeavored to withdraw the foreign body through a large evacuating catheter by suction with an aspira-

tor, without avail. It then occurred to me to use the cystoscope, and Mr. Hurry Fenwick, who was present, passed it at my request. By means of this instrument those who were with me were able to see a branched piece of grass lying on the right base of the bladder. It was then an easy matter for me to seize and extract it with the lithotrite. The patient left the hospital on the following day, none the worse for his escapade.

Suction, with a large-eyed evacuating catheter and an aspirator bottle, as used for lithotrity, is an efficient means for extracting some foreign bodies of a yielding nature. I have recorded an instance" where a man passed a long piece of bacon rind up his urethra, and some days afterward a stiff pig's bristle several inches in length. Symptoms of bladder irritation supervening, I adopted this method, and feeling something engaged in the eye of the catheter, after a few movements of the water in the syringe, I withdrew it together with the bristle which the catheter contained. Nothing was seen of the bacon, which was either dissolved or expelled, as after what was done all further symptoms of bladder irritation disappeared.

In 1864, a case was related at the Liverpool Medical Society, by Mr. Robert Hamilton, where he had removed from a man's bladder portions of calculous concretion formed on a feather, which had been passed by the patient for the relief of stricture. Here lithotomy was performed, as from the nature of the stricture lithotrity was hardly possible.

In the following instance a foreign body was removed from the bladder by means of the lithotrite:

CASE.—W. O., aged 38, a militiaman, was admitted into the Liverpool Infirmary on May 22d, 1877, when I was attached to that institution. His statement was to the effect that on the previous night, when under the influence of liquor, a pencil-case had been introduced up his urethra by a prostitute, in whose company he had been. He did not appear, however, to have discovered anything amiss until the following morning, when certain uncomfortable sensations in the region of his bladder made him come to the conclusion that the lost pencil must be there. From his manner I was at first inclined to think the man was insane, but on hearing that the surgeon of his regiment had discovered a foreign body in his bladder, and had sent him to the Infirmary, I at once examined him. Upon doing so with a sound, the foreign body appeared to be lying obliquely, partly in the bladder and partly within the prostatic urethra. I first attempted to remove it by the extractor, described in Reliquet's "Traité des Opérations des Voies Urinaires," and known as the instrument of Messrs. Robert and Collin, but failing, a lithotrite was passed. By this the pencil was carried on completely within the bladder, where it was seized transversely. In this position it was impossible to extract it; however by gradually rotating the lithotrite toward one side,

while the pencil was within the blades of the instrument, I succeeded in reaching one end, when the pencil was removed, point foremost, without any further difficulty or damage to the urethra. The exact

Fig. 35.—Pencil-Case Removed From the Bladder. Actual size.

size of the pencil-case is represented in Fig. 35. The patient soon passed urine naturally, and on the following day appeared in no respect the worse for what had been done.

The difficulty in removing foreign bodies, such as pieces of bougie, from the bladder is due to their being seized transversely by forceps or the lithotrite. This difficulty Messrs. Robert and Collin have endeavored to overcome by the use of an instrument something like a lithotrite (Fig. 36), the blades of which are so arranged that, on

Fig. 36.—Extractor of Foreign Bodies of Oblong Shape.

seizing a body, such as a piece of bougie, it is rotated and its long axis is made to correspond with the course of the urethra. The bladder should be partly distended with water before the extractor is introduced.

Perhaps more remarkable than the instance of the pencil-case just recorded, is one where I removed by cystotomy the whalebone mouth-

Fig. 37.—Stem of Tobacco-Pipe Removed from the Bladder.

piece of a tobacco-pipe (Fig. 37), encrusted with phosphates. As to how the foreign body got into the bladder the patient must speak for himself.

Case.—R. H., aged 33, a seaman, was admitted into the Liverpool Royal Infirmary on June 23d, 1884, suffering from symptoms of vesical irritation. The history showed that eight years previously he had had gonorrhœa, and more recently he was admitted into a hospital

in Wales with a fractured leg. I found him suffering from stone in the bladder. Upon examining the calculus with the lithotrite it proved to be large, soft, and peculiarly shaped. The last-mentioned circumstance determined me to cut instead of crushing. On June 27th, I performed lateral lithotomy, and removed a phosphatic calculus, which broke under the grasp of the forceps and disclosed the whalebone mouthpiece of a tobacco-pipe, to which a small piece of rotten string was attached. It was noticed that the smell of tobacco in the mouthpiece was distinct. As the phosphatic envelope crumbled under the pressure of extraction, it was impossible to estimate correctly its weight. It must have been very large. About an ounce of these fragments was collected and weighed. The exact size of the mouthpiece is shown in the drawing (Fig. 37). The patient made a good recovery, and left the Infirmary on July 28th. After the operation I showed him the foreign body, and asked whether he could offer any explanation as to how it got into his bladder. He remarked that "he was glad to see it again." He had swallowed it while larking with some companions on board ship three years ago. He felt no pain at the time, nor until last December, when the symptoms of something wrong with his bladder showed themselves. He was frequently spoken to with reference to the improbability of such an explanation, but he would never admit of any other construction being placed on the word "swallowed" than that usually adopted. The case is also an important one as indicating a source of fallacy and of danger in some cases of crushing we undertake.

A case is published [12] where a piece of stick covered with prickles (Fig. 38) was introduced up the urethra of a male in such a way as to render it impossible to draw it out without subjecting the canal to laceration. I quote the following from the record by Dr. G. A. Harris:

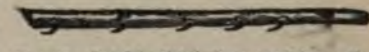


FIG. 38.—Prickly Stick Removed from the Urethra.

"It transpired on inquiry that three brothers, not quite approving of the attention paid by my patient to one of their female relatives, took counsel together, and waylaying him in the jungle at night, overpowered him, and deliberately introduced two and a half inches of thorny cane into his urethra, well knowing from the disposition of the thorns on the stem that it would be extremely difficult, if not impossible, for the victim himself to remove it, and that, in any case, extreme suffering would result; a powerful moral hint being at the same time inculcated in a way that would insure its being remembered through life. I gently pushed the stick back until I judged all the thorns had become disentangled, and, with some little trouble, succeeded in passing a canula over it, and withdrew the piece of stick easily through the canula."

In the majority of instances the history and circumstance connected with the introduction of foreign bodies into the bladder are vague, and the practitioner has often little to guide him in the treatment of the acute symptoms of cystitis, and subsequently of peritonitis, which

supervene. In the example previously recorded and figured (page 214), where a grass-head was passed into the bladder and caused death by perforation and peritonitis, nothing would have saved the patient, even had it been possible to make a full diagnosis, in the absence of a correct history, at the time he was admitted into hospital, but a supra-pubic cystotomy with closure of the perforation into the abdomen by sutures, as is now done in the case of a ruptured bladder. The study of cases and pathological records where foreign bodies have been introduced into the bladder, both in males and females, indicates that in many not only was their removal by operation imperative, but that the method selected should have been of a nature to permit the inspection and exploration of the whole of the interior of the viscus, with the view of ascertaining whether such damage was occasioned by the pressure of the foreign body as to render a perforation imminent. If this were the case in a given instance, a laparotomy must necessarily supervene upon a cystotomy. The high operation would alone permit of our applying such an examination and treatment to the bladder, if perforated or on the verge of perforation, as we should to the intestine if similarly involved. Instances will be found recorded where, though foreign bodies were removed by perineal cystotomy, the patients eventually died of perforation and peritonitis.

Where there exist reasons for believing that a foreign body of some size or of irregular shape, more or less covered with phosphates, is contained within the bladder, and may possibly be on the verge of penetrating it, as has happened, it is better to proceed with a supra-pubic cystotomy for the purpose of effecting its removal in what appears to be the safest as well as the most complete manner. Dr. Gillon [13] reports a case where he removed successfully a phosphatic calculus weighing nearly three ounces, including the nucleus which was a bone penholder over five inches in length, by a supra-pubic cystotomy. The body was lying obliquely across the bladder, and to extract it, it was necessary to divide the penholder with a pair of bone forceps. Any other method of effecting extraction would probably have resulted in a rupture of the bladder and the death of the patient, who was an artisan, aged forty-three.

Among the more remarkable instances where foreign bodies have been introduced into the bladder and have perforated it, is one recorded conjointly by Dr. Benham and Mr. Greig Smith,[14] where the end of an iron umbrella rib was found in contact with the intestines. The specimen as shown in the drawing (Fig. 39) was discovered after death in the body of a demented male epileptic. It is remarked:

"In this case the foreign body passed through the bladder into

the peritoneal cavity for the distance of two inches, apparently without doing any harm. Phosphatic deposit was laid down on the metal in slight amount for half an inch outside the bladder, and this suggests that the walls of the bladder, as it filled and emptied, slipped up and down the instrument, giving opportunity of only intermittent incrustation. It is nothing short of marvellous that no escape of urine into the peritonæum should have taken place."

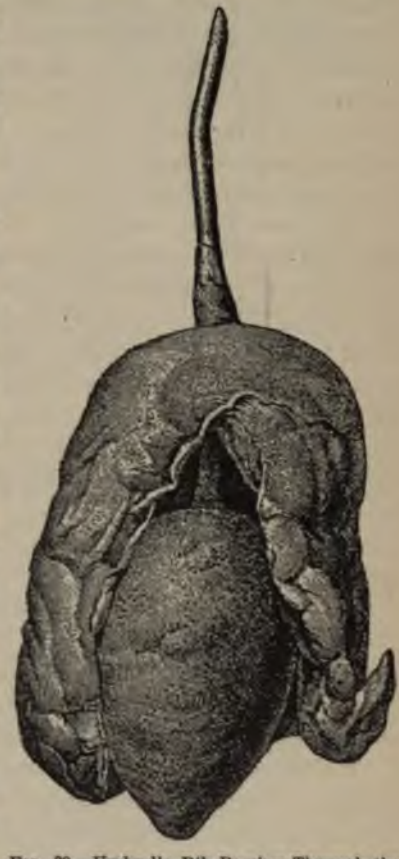


Fig. 39.—Umbrella Rib Passing Through the Wall of the Bladder. A calculus had formed about the end of the rib in the bladder, and there is also a phosphatic deposit for a short distance along the metal outside of the bladder.

Dr. Poulet[14] seems to conclude that such cases of perforation are necessarily and speedily fatal.

The publication of the case of the tobacco-pipe[15] previously referred to led to my receiving several interesting letters from practitioners in reference to the difficulty of diagnosis in cases of this nature. Among these letters was one from Mr. J. H. Wilson, of Thetford, who refers to a case successfully operated on by Mr. Cadge by lithotrity, where the nucleus of the phosphatic mass in the bladder turned out to be a boot-lace. Having anticipated that he had to deal with a foreign body, Mr. Cadge writes: "My suspicions turned out to be correct, for I have removed, at four or five sittings, with the lithotrite, six or seven inches of a black thing which I believe to be a common boot-lace, covered with phosphates. Even with this evidence, the fellow will not admit to having introduced it, or allowed any one else to do so." Mr. Wilson adds: "Like your patient, mine remembered, after a stretch of memory, having swallowed a boot-lace." These cases are of value, as I said before, as illustrating difficulties in diagnosis which, without such examples, we might hardly expect to meet. If patients will not tell us, or do not of themselves know, that they have pencil-cases, pipe-stems, and boot-laces in their bladders, we cannot always be expected to enlighten them at once upon this point.

In using the lithotrite for the removal of phosphatic calculi formed on a foreign body, it must not be forgotten that the latter is sometimes of such a nature as actually to entangle the jaws of the lithotrite and to impact them. This has happened with a hair-pin and the noose of a wire suture, which found their way into the bladder and formed the nuclei for stones. Mr. E. E. Dorr records a case [17] where a man had passed up his urethra a piece of chewing-gum, which, in three months, became largely coated with phosphates. It was successfully removed by the supra-pubic method. It is noted: "It would have been impossible either to have crushed the gum, which was still soft and sticky, or to have disengaged the jaws of the lithotrite." Two instances have recently been recorded where paraffin was injected into the urethra, and subsequently concreted in the bladder. One occurred in the practice of Mr. David Wallace,[18] and the other in that of Mr. Buckston Browne.[19] We are reminded that an article of this nature floats on the urine or upon any fluid the bladder may contain.

Mr. H. C. Garde records an instance [20] where a man pushed a threepenny-piece into his urethra, which, in the course of six weeks, worked its way into the bladder. It was successfully extracted by the lithotrite, though, it is stated, "more than half the coin projected from the side of the instrument."

In connection with the passage of stones from the kidney down the urethra, it has been noticed that their expulsion from the latter canal is often much facilitated by the patient, when feeling that he is about to void one, closing the meatus for a moment on commencing to urinate, so as to obtain the full dilating power of the urine.

Referring to the escape of foreign bodies from the intestines to the bladder, it will be desirable to notice those cases where there can be but little doubt that this has happened. We may put aside, as not bearing upon the subject, those instances of malignant ulceration where the bladder and intestines are thrown into one chasm, and a free interchange of their respective contents takes place. These examples will again come under notice in connection with the subject of malignant affections of the bladder and their treatment. Sir Alfred Roberts, of the Sydney Hospital, N. S. W., records one where the patient, forty-seven years of age, had swallowed a piece of slate-pencil two and a quarter inches long, which was subsequently successfully removed from the bladder by lithotomy. Commenting upon this, the author says: "I have left no stone unturned to elucidate the truth in this interesting case, and I can only state that, after much hesitation, I have arrived at the conclusion that the pencil was swallowed by mouth, and made its way by inflammation and ulceration into the bladder."[12]

A case is recorded by Mr. Brownhill where a woman, aged 26, passed spontaneously by the urethra a stone weighing over half an ounce, the nucleus of which was a hair-pin. Twenty-seven months previously, when she was straightening her hair with the pin in her mouth, one of her companions pulled her hair from behind, causing her to laugh and throw her head back, when the pin slipped down the œsophagus. It was considered probable that the pin passed from the sigmoid flexure of the colon into the left side of the bladder.[22]

Passing to circumstances which arise out of more every-day experiences, the following case presents points of considerable interest:

CASE.—A gentleman, about 50 years of age, was referred to me by Dr. J. Cameron, of Liverpool, in April, 1882, with a note that there was a formation or tumor about the base of the bladder which was palpable to the touch. His history pointed to intestinal irritation of some months' standing. For six weeks he had suffered more or less from diarrhœa and irritability of the bladder, accompanied with considerable abdominal pain. His urine contained pus and air bubbles, and he noticed that micturition terminated with a sort of fizzing noise. There was considerable swelling corresponding with the fundus of the bladder. The mass was about as large as a tennis ball, and felt like a scirrhus. A sound passed into the bladder detected nothing abnormal. The urine was found to contain pus, air globules, and particles of food. About a fortnight after I saw him the patient reported himself as better, both the swelling and irritability of the bladder being less. The urine at times was colored with fæcal matter and contained, by the microscope, some elements of food. He stated that he had recently passed with some trouble, by the urethra, a mass about three-quarters of an inch long which he thought was a stone. This proved to be the end of a rabbit's thigh bone, which no doubt was swallowed, and was the key to the whole case. After this he began to improve, the swelling disappeared, and he rapidly convalesced and resumed his business. He has since enjoyed good health, but at times he is conscious of a little escape of wind into the bladder, and when his bowels are much relaxed there is also some fæcal matter. Probably the fistulous communication has never completely closed.[23]

When the case first came under my notice it seemed to present almost every feature usually associated with a malignant abdominal growth. Had I then committed myself to a diagnosis I hardly see how this conclusion could have been avoided. The progress of the case and the lapse of time, however, indicated that such could hardly have been so, though the age of the patient, the gradual and ill-defined character of the early symptoms, the losing of flesh, and the ulcerous communication between the bladder and intestines, all seemed to point one way until the foreign body was discovered. How greatly the difficulties connected with the case would have been added to, so

far as an explanation of the symptoms was concerned, had the bone been allowed to leave the urethra without being recognized!

Dr. Renaud, of Manchester, has communicated to me the following particulars of a somewhat similar case which came under his observation, where, on the death of the patient from other causes, an examination of the parts was made.

"Mr. A., aged 63, observed that his urine was surcharged with amorphous lithates for the space of one month, after which he noticed that micturition was frequently interrupted by an escape of air bubbles through the urethra. Feeling sceptical, I asked him to void urine in my presence, and, sure enough, the sound of air bubbling was unmistakable. Two months later I noticed that the urine was a good deal loaded with mucus, and that some foreign substance was mixed up with it, which, when placed under a microscope, was found to be a mixture of granular cells, spiral vessels, etc. Nine months after I first saw the patient he died, in consequence of gout and other causes, of which the symptoms here referred to did not represent an important element. The colon was found adherent to the fundus of the bladder, and some coils of bowel were glued together by old and in one part thickened adhesions. In the latter a cherry-stone was found lodged in a false diverticulum or puriform sac, which communicated with the colon by another opening. With this evidence before me, I hardly hesitated to conclude that the granular cells noticed five months ago represented part of a disintegrated kernel of cherry-stone swallowed a long time previously."

The subject of fistula between the bladder and the intestines will again be referred to. With illustrations such as these before us, we cannot be surprised at almost anything that may present in the course of our examination of the urine. We must not forget in connection with this remark that all sorts of deceptions have been practised by means of the urine. I not only refer to persons, for reasons best known to themselves, endeavoring thus to deceive medical practitioners, but to other instances where deceits of this kind are practised for the purpose of legal fraud. Practitioners cannot be too careful, where the statements are of a suspicious nature, in seeing the urine passed in their presence by the patient. In one case that incidentally came under my notice, I feel sure an attempt was contemplated in a life insurance examination to substitute the urine of another person. There was really no cause for this, but the individual referred to had been victimized by quacks, who had succeeded in extracting a considerable sum of money on the ground that he was passing his semen unnaturally, and I believe he merely felt ashamed of the nature of his alleged complaint. However, the case had its lesson in more ways than one.

The female bladder is occasionally found to contain various for-

eign bodies of a nature peculiar to the sex. Some years ago, by means of a pair of fine dressing-forceps, I removed a bodkin, which had been introduced by the patient for the purpose, it was alleged, of extracting a piece of gravel from the urethra.

A case was narrated by Dr. Grimsdale, at the Liverpool Medical Society, in 1865, where he had removed a phosphatic concretion, formed on a large hair-pin, from the bladder of a young lady, aged fifteen years. Removal of the foreign body was effected with forceps, after rapidly dilating the urethra with a dilator. On the second day after the operation she was able to pass water voluntarily; recovery followed, the patient possessing full power over the bladder. In this instance there was some tumefaction above and to the left side of the symphysis pubis, as if an abscess were impending. It is probable that the foreign body might have been expelled in this way had not its removal been effected by surgical interference. I would prefer, under similar circumstances, supra-pubic cystotomy to urethral dilatation. Hair-pins appear to be rather favorite articles for passing into the female bladder, as many cases are recorded.

Foreign bodies in the rectum sometimes excite considerable irritation in the bladder. In an instance that came under my notice the lodgment of a fishbone in the bowel, just within reach of the finger, kept up intense vesical irritability, which disappeared on the removal of the cause. In another case the retention of a small gold-plate, with a false tooth, produced similar effects. Scybala and hardened fæces may act in the same way, especially when the prostate is large and presses on the bowel. Washing out the rectum thoroughly every morning with a copious enema often proves of the greatest comfort in the latter class of cases.

INFLAMMATION OF THE BLADDER.

Cystitis, or inflammation of the bladder, is an affection of frequent occurrence. It is a disorder which often requires some mechanical management, such as the use of the catheter or washing out the bladder; and therefore, for its successful treatment, much depends not only upon the manual skill of the practitioner, but also upon his judgment in the selection of the necessary applications. Cystitis rarely occurs as an idiopathic disorder, but commonly in association with some other derangement of the urinary system. Formerly it was seen as a consequence of the old operation of lithotrity, where, after each crushing, rough fragments of stone were left in the bladder and excited inflammation. This complication often proved so rapidly fatal as seriously to compromise this proceeding. The important

improvement introduced by Bigelow, of crushing and removing the fragments of stone by suction at the same time, disposed of the most frequent cause of acute cystitis we then had to deal with.

Acute cystitis is generally traceable to injuries involving the pelvis and bladder, to the introduction of foreign bodies or septic germs of an irritating nature into the bladder, and to the decomposition of urine. When the bladder is acutely inflamed we have all the local and general symptoms more or less prominent of an active inflammation of a vital organ. There is supra-pubic pain and tenderness, sometimes running into general peritonitis, with vesical and rectal tenesmus, and the process of expelling the scanty high-colored urine is extremely distressing. Sometimes there is retention, but not always. The urine is often remarkable in appearance, resembling thin prune juice, and containing blood and mucus intimately mixed with it. Under the acute cystitis of prolonged retention of decomposing urine, both in men and women, the whole mucous coat may come away entire, or in detachments as a sloughy mass.

A rapid disorganization of the bladder is sometimes observed in association with disease of the spinal cord, and is probably dependent, as Charcot[24] suggests, upon irritation of certain parts of the latter, and more particularly of the gray matter. This is exemplified in the following case:

Case.—T. R., aged 21, a porter, had previous to his present illness enjoyed good health. There was no history of syphilis. Two days before his admission to the Liverpool Infirmary, when at work, he was seized with pain in the bowels. He walked home, took a dose of castor-oil, and applied a mustard poultice to the abdomen. In the night he tried to get up, and found that one leg was useless and numb. In the morning both legs were numb and absolutely powerless, and he was unable to pass his water. When brought to the hospital it was found that there was complete loss of power and sensation in the lower extremities. The urine had to be drawn off, and was found to contain pus and mucus. It was alkaline, and in the course of two or three days large quantities of blood were found mixed with it. Extensive sloughing of the bladder followed, and for some time before death all the urine was passed by the rectum. On post-mortem examination the spinal cord in the lower dorsal region was found softened. On section the distinction between gray and white matter was ill-defined. Under the microscope the large cells in the gray matter were much altered in shape, and dilated vessels and leucocytes were observed in large numbers. The coat of the bladder had sloughed, and abscesses had formed around it, through one of which a communication was established with the rectum.

It seems hardly possible, as Charcot urges, that such acute changes as these could be induced by the mere contact of urine, how-

ever decomposed, or by the introduction from without of any septic material by catheters. The rapidity of the symptoms, in the few instances of this condition which I have seen, rendered all local treatment beyond the use of the catheter practically useless.

In the treatment of acute cystitis we shall do well, in the absence of obvious causes of inflammation, as injuries and such like, to have regard to the possibility of a foreign body having been introduced into the bladder. In a most acute case of this kind it turned out that the patient had passed a grass-head into the bladder, the stalk of which had penetrated the fundus of the viscus, and made its way, together with the urine, into the abdomen (Fig. 34). If there is a cause for the cystitis that can be removed, as for instance a stone fragment, this will be the first indication to fulfil. For relief, reliance will chiefly be placed in warm soothing applications about the part, with anodynes, either local or general. A few leeches applied to the perinæum generally remove the feeling of tension about the neck of the bladder which is often complained of. Demulcent drinks and febrifuges are also useful. I do not know anything which oftener gives relief than introducing a soft rubber catheter, and running into the bladder just as much warm water as can be tolerated with comfort. This may be done frequently, and is always grateful to the patient.

I will now notice those forms of cystitis of commoner occurrence which we meet with as complications of other urinary disorders. We shall recognize the following circumstances under which they happen:

1. As produced by the extension of inflammation from some other part, as in gonorrhœa; this may be called metastatic cystitis.

2. As a consequence of obstructed micturition, as in stricture, or hypertrophy of the prostate—the cystitis of obstruction.

3. As caused by an irritant in the bladder, such as a calculus or a growth—the cystitis of direct irritation.

1. *Metastatic Cystitis.*—It is not uncommon to find cystitis, in various degrees, occurring as a consequence of gonorrhœal urethritis, and, like other metastatic inflammations, the primary disorder often abates as the change in locality takes place. In the slighter forms of cystitis resulting from gonorrhœa, or those provoked by such causes as exposure to cold, we have this condition indicated by a frequent discharge of urine more or less loaded with mucus. In the severer forms, in addition to constitutional fever, the bladder is intolerant of the presence of urine within it, as indicated by frequency of micturition, and tenesmus produced by the contractile power necessary to expel. The urine becomes purulent, and a discharge of blood not infrequently terminates the

act of its expulsion. I have observed the greater liability to cystitis and bladder irritation, as a complication of gonorrhœa, at seasons of the year when sudden changes in temperature are apt to occur. Hence the importance of providing against this by suitable clothing and by avoiding exposure to keen winds.

The treatment of this kind of cystitis must be in correspondence with the degree of inflammatory action that is taking place. In the milder forms, where irritation best describes the extent to which the bladder is implicated, the suspension of any kind of abortive local treatment, so far as the gonorrhœal discharge is concerned, is necessary. Rest, in the recumbent position, and soothing applications, in the form of hot opiate fomentations and sedative suppositories, must be substituted. Of the demulcents I have been in the habit of prescribing, I find the decoction of the ulmus fulva or slippery elm, in combination with the succus hyoscyami, affords the speediest relief. In cases of gonorrhœal cystitis, where the disorder has a tendency to become chronic, frequency in micturition and purulent urine remaining after the more acute symptoms have subsided, benefit will be found from the use of copaiba, or the oil of yellow sandalwood; these remedies are, however, not well borne where there is general febrile disturbance.

When there is evidence from the symptoms and the presence of gonorrhœal bacteria that the bladder is similarly affected with the urethra as a consequence of the specific inflammation, local treatment is generally required in addition to the sterilization of the urine from within by such bactericides as quinine or boracic acid. This is best done by passing a small rubber catheter well anointed with carbolized vaseline into the bladder and then moderately distending it with half a pint or so of some disinfectant. The catheter is then withdrawn and the patient spontaneously expels the contained fluid. In this way not only is the mucous membrane acted upon but the urethra is flushed in the most thorough manner. This process should be carried out once or twice in the twenty-four hours. By this means the urine will soon present a normal appearance. Where there has been a chronic infective gleet this will often also permanently disappear under this process of irrigation. I usually prefer nitrate of silver in the proportion, to commence with, of two grains, to the pint of warm distilled water, the strength of the solution being gradually increased until half a grain to the ounce of water is reached. Neutral sulphate of quinine, one grain to the ounce of water, is also very efficacious. Bichloride of mercury, 1 in 20,000, may also be used as an efficient bactericide, but even in these proportions it is apt to cause pain and subsequent irritation.

2. *Cystitis of Obstruction.*—Passing to the cystitis of obstruction, we shall find that this presents itself to our notice as chronic and sub-acute. The chronic form is usually seen in cases of enlarged prostate and in some of the commoner varieties of organic urethral stricture. The cystitis of the enlarged prostate is due, not alone to some urine remaining in the bladder, but also to the direct irritation produced by protruding masses of the hypertrophying part. This irritation leads to an excess of mucus being thrown out, and its accumulation with a residuum of urine in the most dependent portion of the viscus. The result of this is decomposition of the urine and the evolution of ammonia. By the constant presence of such compounds the bladder becomes inflamed, intolerant of its contents, liable to slight hemorrhages, and incapable of performing its natural function with any comfort to the patient. Going a stage further on, the dilated ureters, and perhaps the pelves of the kidneys, share in these changes, and thus serious complications are almost imperceptibly added. In certain cases of stricture much the same sort of thing occurs, though for obvious reasons the amount of the vesical mucus is not so great as in the former illustration; still it is sufficient to produce similar changes in the urine. This excretion is rendered alkaline and ammoniacal, the bladder becomes irritable, the patient is constantly straining to emit a few drops of urine, and in like manner with the cystitis of the large prostate, the ureters and kidneys may eventually become involved.

The indications for treatment are tolerably clear. Remove the cause and the consequences will subside, either spontaneously or with the assistance that art can render. In the case of the large prostate this cannot always be done to the extent we could desire, at all events in many of those instances where the growth has been of a steadily progressive character. The obstruction, if it cannot be removed by operation, may be largely remedied by the judicious use of the catheter. How and when the catheter is to be used must to a large extent be left to individual experience and discretion. Where cystitis is due to chronic organic stricture, it will be found to decline spontaneously as the obstruction yields to appropriate treatment. Week by week, as dilatation proceeds, the bladder loses its irritability, and the alkaline urine, perhaps ammoniacal and charged with mucus, resumes its normal reaction and appearance. The next indication is to prevent the contents of the bladder keeping up or adding to the inflammation which has already commenced. Offensive urine and tenacious alkaline mucus are in themselves sufficient elements for the production of inflammation irrespective of the obstruction in the canal. To correct this, and to remove excess of mucus, the bladder may re-

quire ablution, just as the nasal passages do when they are the seat of offensive ozæna. These details will be referred to when I come to speak of the process of washing out the bladder.

The *acute* cystitis of obstruction is a serious form of the disorder which is also seen in connection with stricture of the urethra and prostatic enlargement. These cases generally present themselves to our notice in the following way: We are called to see a patient who has been suffering from stricture for some years; the difficulty has gone on increasing, the urine has become ammoniacal, and his rest is hourly disturbed to pass water, which he does in small drops after much straining. Broken down with all these symptoms he becomes feverish, his tongue is brown, and he exhales a sickly sort of ammoniacal odor. In addition, his temperature is high, pulse rapid and feeble, and he may have had a rigor followed by perspiration. Probably with difficulty, a small catheter is passed, and some highly fetid urine escapes. Both the general and local state indicate a condition of acute cystitis with inflamed or surgical kidney. I have seen a good many cases of this kind, and about their treatment no doubt whatever can be entertained. The position is this: The patient cannot wait to derive the benefit of dilatation. No operation for the stricture, such as internal urethrotomy or a divulsion, is to be recommended, as the sufferer would be almost sure in his condition to die acutely pyæmic. The only way of dealing with him under these circumstances is to regard his bladder in the light of an acute fetid abscess requiring an opening at its most dependent point. It would be just about as rational to propose to treat a fetid ischio-rectal abscess that was poisoning a man acutely, by putting a trocar into it, as to think of relieving a septic suppurating bladder from obstruction with a catheter only. A grooved staff, or, failing this, anything to indicate to the finger the line of the urethra, should be passed, and a perineal opening made into the membranous urethra of a size to admit a large drainage-tube. The urine should not all be removed, if the catheter is first introduced, as it is as well to leave sufficient behind to fully realize the effect of the incision that is made. The bladder should then be washed out and allowed to drain through the opening. In cases of the kind to which I am now referring, where this course is promptly taken, I have seen patients pass as it were in a few hours from approaching death to rapid convalescence. By this treatment I have here and there lost a dying patient, but, on the other hand, I know that I have saved many more who would otherwise have died. The opening gives immediate relief, and if it is made to correspond in size with the drainage-tube to follow, there is really no bleeding or further trouble.

In the treatment of less urgent forms of cystitis, reference is often made to the reaction of the urine as indicating the necessity for administering either acids or alkalies. Our object should be to obtain that condition of the excretion which most nearly corresponds with its normal state, as we sometimes find that alkalies are poured in with a vigorous hand and regardless of the fact that healthy urine has an acid reaction. Still we must not forget that a highly acid condition of the urine is often intensely irritating to the inflamed mucous membrane with which it comes in contact. Sir George Johnson has shown the value of milk in some chronic cases of cystitis, and of skimmed milk in others. The pharmacopœia contains a number of drugs which seem to exercise a soothing or anodyne action upon the mucous membrane of the bladder and urinary organs generally; of these I would mention pareira brava, uva ursi, and buchu. Amongst the best demulcents are well-made barley-water, the ulmus fulva or slippery elm, and the triticum repens. Belladonna and hyoscyamus are often extremely useful in allaying the irritability of the bladder associated with cystitis. There is a combination of the infusions of uva ursi and hops, with a little carbonate of soda added, the use of which will be often of value in these cases. Of other drugs I have found serviceable in varying degrees and kinds of chronic cystitis, I may here mention hyposulphite of soda in half-drachm doses; its virtue in purulent urine is sometimes remarkable. Salol, the syrup of tar, saw palmetto, salicylate of soda, pichi, and the fluid extract of the Collinsonia canadensis have also proved themselves of service.

Among fruits, the common blackberry appears to exercise a sedative effect on the mucous membrane of the urinary passages. My attention was first directed to this by two old practitioners who were in the habit of prescribing it in cases of chronic cystitis. I have often found blackberry-tea, prepared from the jelly, an efficient and not a disagreeable demulcent in these cases. There are other fruits and vegetables which will occasionally be found useful. For instance a distinguished member of our profession writes me: "It is a curious thing that when I eat gooseberries, not only is the urine increased in quantity but it is always clear and free from mucous deposit, and normally acid." The ordinary table celery, well boiled, is often serviceable as part of the diet of persons liable to cystitis. I have, on the other hand, met with an instance where the eating of much asparagus invariably caused hæmaturia. An excess of mucus in the urine may sometimes be corrected by ten minims of terebene in a capsule three times a day, and the same may be said of a combination of the oils of eucalyptus and of cubebs. In the treatment of chronic inflammatory affections of the bladder many of the balsams and terebin-

thinates may be recommended. The use of saccharin has been also advocated for this purpose by Dr. Little [25] of Dublin.

Opium must not be used indiscriminately. To give a few hours' repose in this way to a patient who really requires his urine drawn off and the bladder washed out is, on the face of it, not good practice; though when such points have been attended to, it is often invaluable in removing the extreme sensitiveness of the parts which is due to the disease. The constipation that follows the use of this drug in chronic sufferers from cystitis negatives the good otherwise gained by the sleep and repose that are obtained. The addition of belladonna to the opium sometimes removes the constipating effect of the latter. I cannot say that the bromides are of much service in this class of cases, unless the trouble arises more from nervous than from physical causes. Some persons' annoyances seem invariably to gravitate toward their large prostates.

Though, as a rule, retained and decomposing urine is the cause of the offensive smell sometimes noticed in these cases, still, in spite of catheterism and irrigation, a disagreeable odor may remain. Under these circumstances, the administration of naphthalin in a pill, containing two or three grains, enclosed in a gelatin cachet, will be found useful. If given three or four times a day the odor of the drug will be found to overcome the disagreeable one the urine generates. Benzoic and boric acid, benzoate of ammonia and chlorate of potash, administered internally, are also of service where the urine undergoes change of this kind. It is by sterilizing the urine that medicines of this character do good.

To alleviate the extreme irritability of the bladder which often remains after the more active symptoms of inflammation have passed away, a solution of morphine, injected into the bladder with a gum-elastic catheter to which a ball syringe is attached, often gives the patient a good night after rectal suppositories in various forms have been tried.

For a similar object, I sometimes employ vesical suppositories, containing morphine, belladonna, bismuth, and other soothing agents. I put these into the bladder by means of a suppository-catheter, made for me by Messrs. Krohne and Sesemann, of London. The instrument consists of a silver catheter, open at the end, in which the suppository is placed. By means of this instrument the whole of the urine is first drawn off, after which, by pressing the stylet, the suppository is projected into the bladder. They are made of the oleum theobromæ, and are so shaped as to fit in the open end of the catheter, thus giving it the appearance of an ordinary instrument, and facilitating its passage into the bladder. The shape of the suppository is

shown in the sketch (Fig. 40, *A*); they contain various medicinal applications. A grain of morphine, introduced into the bladder in this way, and repeated twice in twenty-four hours, has completely relieved distressing symptoms of irritation. I have extended the application of drugs in this shape to other cases where astringents are indicated.

Fig. 40.—Vesical Suppository Catheter. *A*, Suppository.

A member of our profession writes me: "I have received more benefit from the suppositories of cantharides than from all the remedies I have tried during the twelve years I have suffered from retention."

Dr. Dennis, of New York, thus refers[26] to this method of medicating the bladder in a case of hemorrhagic cystitis complicating typhoid fever: "After the bladder had been washed out with the antiseptic solution, iodoform suppositories were introduced into the bladder by an instrument invented by Mr. Reginald Harrison. The antiseptic solution cleansed the bladder, and the iodoform suppositories disinfected the residual urine. It was a remarkable clinical fact, that eleven days after the discontinuance of the suppositories the odor of the iodoform was present in the urine."

There are causes of cystitis other than those I have previously enumerated as the commoner ones. A paralyzed bladder, as we see in disease and injury of the spinal cord, is, sooner or later, almost sure to become an inflamed one in the way that has already been explained. Catheterism and washing out the bladder will do much toward mitigating the distress of these patients and averting a fatal issue; for, where recovery has followed, much of the success was due to the absence of inflammation of the bladder. In employing catheterism in these cases, we ought not to forget that, owing to the absence of sensibility in the parts, much damage may be inflicted by an injudicious employment of instruments, without the patient expressing that consciousness of pain which otherwise he would do. The greatest care should consequently be exercised in drawing off the urine to avoid any lesion of the urethra or bladder, which, considering the state of the urine, would be sure to provoke further complications. Almost the whole comfort of the patient suffering from fracture of the spine depends upon the manner in which his urinary symptoms are anticipated and managed. Perineal cystotomy with tube-drainage has been practised in these cases by Mr. D. Harrisson, with the ob-

ject of dispensing with catheterism altogether, but I have no experience of it myself under these circumstances. Mr. Wallis[27] also records an instance where perineal cystotomy and drainage was practised, with temporary advantage, in a patient with fractured spine who was dying from cystitis. The use of the catheter was thus rendered unnecessary. I can, however, indorse the remark made by the late Dr. Hilton Fagge, that the tendency of urine in paraplegia to putrefaction may be checked by the administration of salicylic acid by the mouth. There are cases of chronic cystitis in the male where the expediency of performing cystotomy and of draining through the perinæum may with much propriety be considered for the purpose of giving the bladder a complete rest, both from the operation of catheterism as well as from its own irritable contractions or spasms. In some instances, where all other means have been tried and failed, very satisfactory results have been obtained, that is to say, the patients have derived permanent advantage. The details of this proceeding will be discussed in connection with the operation of perineal puncture and drainage.

Atony of the bladder is often seen in connection with cystitis. When occurring suddenly, the question sometimes arises, Should a catheter be permanently retained in the bladder? My opinion corresponds with the following remark by the late Mr. W. Hey, of Leeds: "I feel sure that a patient sooner regains the power of emptying his bladder spontaneously when the catheter is withdrawn after each time it is used than when it is retained." Temporary atony is sometimes seen following pressure from over-retention of urine, just as the arm may be temporarily paralyzed by lying on it. To prevent atony becoming permanent much may be done by the mechanical measures that have been advocated. In addition, medicines such as iron, nux vomica, and strychnine have proved useful. The tincture of cantharides is an old-fashioned remedy, which, in addition to its diuretic properties, probably exercises a direct stimulating action upon the bladder by its presence in the urine. Von Langenbeck has found benefit from the hypodermic injection of ergotin.

Care must be taken to draw a distinction between the inflamed bladder that is either entirely or partially atonied because the patient is ataxic, and the commoner form of local paralysis to which reference is here made. Inflammatory atony is not unfrequently seen as a remote consequence of syphilis in middle-aged men. Here both local and general treatment will be requisite. Atony with cystitis, though associated with urethral stricture, is sometimes due to a central and not a peripheral cause; hence it is well not to promise too much even after the stricture has been disposed of. I have known

the bladder treated somewhat actively, with the view of arousing its supposed dormant action, where attention should also have been devoted to the state of the nerve centres, which was the primary cause of the suspended action in the part.

In the following case reference is made to the treatment of ataxia by suspension, so far as the bladder symptoms seemed to be influenced by the process:

CASE.—A male patient, aged about 40, came under my care early in 1890, with locomotor ataxia of two years' duration. He had difficulty in commencing to pass water, which was increasing, with cystitis and ammoniacal urine. Under Charcot's advice it was agreed that suspension should be tried in conjunction with the administration of ergot. I completely suspended him on fourteen occasions in two months, from sixty to ninety seconds at a time, with the result that the bladder symptoms entirely subsided, and the patient was able to resume active official duties. The patient had no stricture and no urethral instrument was used.

In the treatment of cystitis as it occurs in females, we can have no better instructions than those contained in a practical paper by Dr. J. Braxton Hicks. The author points out how little is to be expected from internal remedies, beyond correcting abnormal states of the urine and disordered functions, and how much may be done by local treatment. Reliance is chiefly placed upon washing out the bladder with slightly acidulated warm water until it is clear of phosphates and mucus, and afterwards injecting, with a view of its retention, a solution of morphine. Subsequently permanganate or chlorate of potash is employed in a similar manner. On the subsidence of the acuter symptoms, injections of tannin or of perchloride of iron, followed by morphine, are substituted, and are again changed, as the bladder becomes less sensitive, for more potent astringents, such as nitrate of silver. "The benefit of such management is very marked in cases of paralysis where, from retention or the rapid ammoniacal decomposition of the urine, the pain and constitutional irritation are very distressing; and thus we can often lessen the chance of the extension of the irritation to the kidneys. Again, in malignant disease, the simple injection of acidulated warm water gives amazing comfort, removing the phosphates and ammonia, and when to this is added the morphia, a wonderful comfort is felt. Indeed, so much relief is obtained that, with a large calculus in the bladder, its presence is almost entirely unfelt if morphia be daily injected." [28]

There are in women forms of chronic cystitis and vesical irritability of a very obstinate nature where it is difficult to detect any structural alterations. In some of these cases Mr. Teale [29] has shown that great benefit follows the induction of a condition of transient incontinence

of urine by over-dilatation of the urethra. This is a mode of resting the bladder which, like others where a temporary vesico-vaginal fistula is established by incision, may with advantage be employed in obstinate cases of the kind referred to. For the sympathetic or local irritation alone, which so frequently attends urinary tuberculosis, I have not met with such results in my own experience as would make me commend this principle of proceeding. The reflex irritation of urinary phthisis is best met by anodynes.

In all cases of chronic cystitis whatever may be the cause, the practitioner should be alive to the possibility of a phosphatic stone forming. These concretions sometimes accumulate with great rapidity, and when detected are apt to lead the patient or his friends to suspect that the stone, which perhaps some one else detected, was the cause and not the consequence of the disorder undergoing treatment. I have on several occasions known phosphatic stones, of, say, an inch in diameter, form in a few weeks.

By the kindness of my colleague Mr. Heycock, I had the opportunity of seeing, in his practice at St. Peter's Hospital, a case of much interest and importance. It was one of acute cystitis in a man of about 40, with a urethral stricture of some standing, where the entire mucous membrane of the bladder exfoliated and was withdrawn in the form of a loose bag through a perineal cystotomy. The latter was rendered necessary by the fetid character of the urine and the recurrence of retention from impaction of the detached membrane in the outlet from the bladder. A drainage-tube was placed in the bladder through the wound. Immediate relief followed the operation, and the patient rapidly progressed toward recovery. The mucous coat had a granular appearance, and was much roughened by the deposition of phosphates upon it.

These cases are, it is hardly necessary to state, widely different from others where a false lining or membrane appears to form within the bladder, and keeps up a cystitis. Dr. Cabot, of Boston, U. S. A.,[30] reports such a case, under the name of pacchydermia vesicæ, where, on opening the bladder above the pubes to relieve urgent symptoms it was found "that a thick membrane could be detached from the diseased surface, and with care could be peeled off with the fingers in sheets of one or two square inches in area. It was loosely attached, and after removal left a smooth surface which bled but slightly. The wall of the bladder which it left felt soft and supple." The patient steadily improved, and the following year it is stated he was able to resume hard work. Pathologically the membrane is described as "made up entirely of epithelium, from fifty to one hundred times as thick as the epithelial layer normally existing on the bladder wall,

and its nourishment was provided for by papillæ thrown up by the connective tissue below." Referring to treatment, other than by operation, it is observed that nitrate of silver injections seemed to answer in allaying inflammation. Dr. J. P. Bryson suggested that, as he had had excellent results in the treatment of chronic cystitis from injections of salicylic acid, this drug would be applicable here, as it had the power of removing warts, corns, and other growths of hyperplastic epithelium. Dr. Cabot expresses his acknowledgments to a paper by Posner, upon "Dermoid Changes in Mucous Membranes,"[21] for the pathological consideration of the subject. In a case I saw recently, in conjunction with Mr. T. P. Teale, a very similar state of things was found on opening the bladder above the pubes. Mr. Teale thus describes it in a letter to me: "The condition of the bladder was such as I never experienced. The whole of the mucous membrane was in a velvety or granular condition, and was almost completely lined by a membrane (diphtheritic?) like soft writing-paper. This membraneous material seemed gradually to disappear in the course of a week or two. I had a good view of the neck of the bladder through a small Ferguson's uterine speculum. It was fringed by feathery warts or elongated papillæ, a greater part of which I removed by forceps and scissors."

The question has arisen in practice as to whether a person suffering from chronic cystitis and decomposing urine is capable, during the continuance of these symptoms, of procreating. The evidence is against the possibility, so far as I have been able to observe, where the urine is from such causes loaded with bacteria.

Toilet of the Bladder.—After the general consideration of cystitis, I shall now refer to what may appropriately be called the toilet of the bladder. This will include, first, the mechanism, and then the materials appropriate to each class of case. In the first place, it is well to remember that the process of washing out some bladders is a very different thing to what it is in others. This will readily be understood by comparing a pouched bladder with a tolerably normal one. In the former case, unless the siphon-action of the catheter is perfect, a considerable amount of urine, perhaps loaded with mucus or pus, may be left behind to decompose and become swarming with various kinds of bacteria. Hence the catheter should be gently moved about and partially withdrawn as the flow ceases, to see if another collection of urine can be tapped. As I have elsewhere stated, in some instances it is even well to let the patient lie over on his side, so as to render the abdomen somewhat dependent, before the catheter is finally withdrawn. It can be understood how a metal catheter may positively shut down a sort of prostatic valve by its weight, and render, from the

position of the exit aperture, the complete emptying of the bladder an impossibility.

For ordinary purposes, I usually employ a soft silk or rubber catheter with a bevelled eye, and a rubber bottle holding four or six ounces of fluid, with a brass nozzle and stopcock, which can easily be screwed on, or, what is better, be connected by means of a bayonet joint. The nozzle should taper to a fine point so that it may fit catheters of various sizes. I formerly used double-current metal catheters, but these I have discarded, for the reasons that an unyielding instrument is not so generally applicable as a flexible one, and because there is no object in having an arrangement for the synchronous flow of fluid into and out of the bladder at the expense of the calibre of the tube. The soft catheter having been introduced, and the rubber bottle filled and connected with it, the fluid is gently pressed by the hand onward to the bladder. Two or three ounces usually suffice for a time, the tap is again turned and the fluid retained in the bladder for a few moments, and then allowed to escape. This process may be repeated two or three times until the return fluid indicates that the object intended has been attained. The process should be a painless one, without provoking either bleeding or spasm. Mr. Buckston Browne [32] has described a tube which can be fitted to almost any catheter, by which a Higginson's syringe may be adapted for filling the bladder, while by raising the finger from over one of the openings, the current is reversed and the fluid ejected.

I used to wash out with a glass funnel to which about two feet of rubber tubing and a catheter were fitted. When the funnel is elevated and water poured into it, the latter, by hydrostatic pressure proportionate to the calibre and length of the tubing, flows into the bladder, and, upon the funnel being depressed below the level of the patient's pelvis, escapes.

Where the bladder is much pouched or irregular in shape, it is better to employ hydrostatic pressure in the form of a reservoir or rubber bag (which is convenient for travelling), as shown in Fig. 41, representing an arrangement described by Dr. Keyes. By this plan the bladder can be very gradually filled, so as to float out of these various depressions and crevices pieces of tenacious mucus which otherwise would remain behind and keep up irritation and bacterial decomposition. From the sketch (Fig. 41) it will be seen that the apparatus consists of a rubber bottle (*A*) capable of holding a pint of fluid, which can be suspended to any convenient hook; a piece of tubing (*B*), five feet in length, terminating in a stopcock (*C*), which permits fluid to flow either through the catheter end (*D*) or the outlet pipe (*E*), according to the direction in which the tap is turned. A

conical metallic catheter mouthpiece (*F*) completes the connection with the catheter (*G*). A soft-rubber catheter is generally preferred. The instrument is used in the following way: The bag or reservoir, being filled with the fluid to be injected, is hung up about six feet from the floor. The stopcock (*C*) is then turned until some of the fluid escapes, so that no air is allowed to enter the bladder. The patient, being in the erect position, then introduces the catheter and connects it with the tubing. By the alternate action of the tap (*C*) the fluid is made either to enter the bladder or to escape; if the latter, it passes into the receptacle (*H*). The

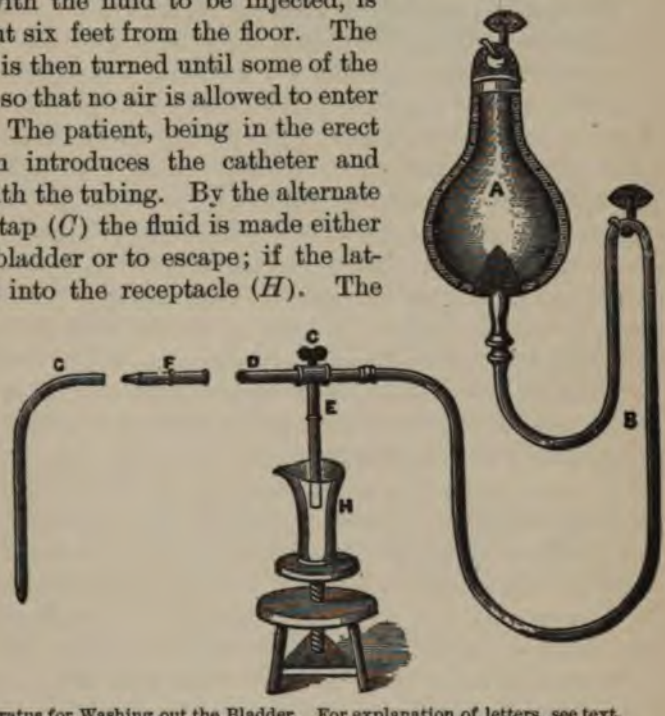


FIG. 41.—Apparatus for Washing out the Bladder. For explanation of letters, see text.

instrument can be adapted to the recumbent position, and also enables patients to perform this operation readily without assistance.

Care should be taken to avoid forcing air into the bladder when the urine contains blood or pus, as it sometimes leads to putrefaction and the evolution of gas, which may cause spasm. As the bladder is expelling the last portion of the injection, if the surgeon is holding the catheter, he sometimes feels a slight click or concussion, which the patient with a sensitive bladder is conscious of and would rather avoid. I believe it is caused by the mucous membrane being drawn into the eye of the catheter as the bladder is emptied of the last few drops. It is prevented by watching the flow, and withdrawing the catheter until the end is well within the prostate as the last portion of fluid escapes. Catheters for this purpose should have the opening of moderate size, with the edge bevelled, so as not to scratch the urethra; to avoid more of the catheter being introduced into the bladder than necessary, the opening should be close to the end of the

instrument. When using rubber bottles for washing out the bladder care should be taken that they are thoroughly aseptic and not structurally disqualified by age.

We have, I think, been disposed to make this excellent practice of irrigation a fashion in bladder cases, where, though there may be a call for the catheter, the ablution following may prove unnecessary. In some cases of partial retention where the catheter is required, it must not be forgotten that so long as the vesical mucus is normal in quantity and quality, it serves a purpose in protecting a surface, which, by reason of the inequalities of the bladder arising out of the enlargement of the prostate, has no means of completely contracting or covering itself, until time has elapsed for the excretion of the requisite amount of residual urine. I am reminded of this when I hear patients complaining of irritability of the bladder, which takes a little time to subside, directly after they have been washed out.

Washing out is required for various purposes, most commonly for the removal of mucus or muco-pus, which often collects in the dependent parts of the bladder, especially where the prostate is large. If left to accumulate, this viscid secretion excites spasm and causes ammoniacal decomposition of the urine, thus adding considerably to other sources of irritation. I know no better solvent for this than common salt, in the proportion of a teaspoonful or so to a pint of tepid water, for use with an irrigator. In connection with this remark Dr. Gouley [11] has pointed out that bladders which have long contained purulent, slimy urine do not bear the contact of limpid fluids of low specific gravity well at first, and it is therefore necessary in some instances to increase artificially the density of the water. Such a lotion is less irritating to the mucous membrane than plain water, as we recognize in the treatment of ozæna. In other instances, a solution of boracic acid answers better. Very hard waters should not be used for such purposes. It is just as easy "to chap" the bladder in this way as the hands. Distilled or rain water may be substituted.

The next class of cases includes those where the contents of the bladder are rendered offensive by decomposition. We know how disagreeable the urine can become both to the patient and to the practitioner. Carbolic acid will be found an appropriate antiseptic, but it must not be used stronger than one in eighty, otherwise, if it becomes absorbed, it may occasion that peculiar condition known as carboluria. Solutions of sanitas, boro-glyceride, and sulpho-carbolate of soda may also be employed for the same purpose. Resorcin, creolin, and nitrite of amyl are also recommended as useful disinfectants. When the urine remains purulent after cystitis nothing often succeeds better than a quinine wash, as first recommended by Mr.

Nunn,[34] who speaks of its action as a bactericide. The neutral sulphate should be used in the proportion of one grain to an ounce of distilled water to commence with, and if the solution is not quite clear, a drop of dilute muriatic acid may be added. Some of the injection may be left in the bladder. The internal administration of quinine, in doses of five grains, not only acts as a sedative to the bladder after cystitis, but is useful in sterilizing the urine. Its efficacy for this purpose has been urged by Dr. Simmons,[35] who, in explaining the nature of this action, refers to an observation by Dr. Kerner, that seventy per cent. of the drug is eliminated by the kidneys in from three to twenty-four hours after it has been taken. Quinine is employed in this way after operations on the urethra, with the best results. It sometimes happens that after attacks of cystitis the urine remains alkaline, and there is a tendency to throw down phosphates, which often concrete in the form of a mortar-like substance. From five to ten grains of citric acid in a pint of warm water, used as an injection, will often correct this disposition, which is probably primarily due to excess of vesical mucus. The mineral acids are not well borne locally.

Sir William Roberts[36] has suggested that the lactic fermentation may be made use of as a counter-septic agent in cases of ammoniacal decomposition of the urine, and that thus the formation of phosphatic concretions may be prevented.

I have availed myself of this suggestion with obvious advantage in some cases of ammoniacal urine where there was every disposition to form stone. For this purpose, as a preliminary, the bladder should be washed out with a solution of citric acid in the proportion of ten grains to a pint of tepid water. After this has been done, an ounce of water containing a drachm of malt extract (bynin) is injected into the bladder, and retained there.

The mucous membrane sometimes remains sensitive after the acuter symptoms of inflammation have subsided, when a soothing or anodyne solution will be serviceable. For this purpose a solution of borax in glycerin, with tepid water added, makes a good wash. Sir Henry Thompson's formula is as follows ("Diseases of the Urinary Organs"): Glycerin, two ounces; biborate of soda, one ounce; dissolve, and add two ounces of water; half an ounce of this solution to four ounces of warm water is a suitable proportion. Some of the most troublesome cases of irritable bladder, arising from this cause, yield entirely to the daily use of a solution of bismuth. A tablespoonful of the lac bismuthi (Symes & Co.) to six ounces of warm water represents an appropriate strength. As a local application I have found this salt as useful in bladder affections as it appears to

be in other disorders of the mucous tract, where it acts mechanically in protecting or coating over the irritable membrane. Other cases of this kind yield to irrigation of the bladder with tolerably hot water. We may commence with it at 98° Fahr., and gradually increase the temperature to 115° or 120° Fahr.

In tubercular ulceration of the bladder no application is so useful as a wash of corrosive sublimate; under its use as an antiseptic I have known the bacilli disappear from the urine and the ulcers heal. It must be used in a dilute form; 1 in 20,000 parts is strong enough to begin with. In operations on the interior of the urethra, where a wound is inflicted or the canal is abraded, I generally leave an ounce or two of this solution in the bladder so as to act as a protection to the sore by sterilizing the first portion of urine that is passed, and connect immunity from rigors and fever principally to this practice. For the same purpose, in tubercular ulceration of the bladder, a solution of iodoform in mucilage, in the proportion of five grains to an ounce, is used, and I have frequently seen good from it, but the offensive smell of the drug is an inconvenience. In free hemorrhage from the bladder, injections of extract of witch hazel and hot water have proved of service, but as a rule the less we interfere instrumentally in these cases the better. To wash out a clot causing irritation to the bladder there are no better means than warm water and Clover's catheter and suction bottle used for withdrawing *débris* after lithotrity.

When washing out the bladder care should be taken to examine the fluid employed in the process, when expelled, by putting it into a glass receptacle. So long as flakes or masses of mucus and lymph are seen, we have evidence of material existing which can cause and maintain bacterial life. Further, the microscope shows that such products of inflammatory action going on in the bladder are capable of acting as minute foreign bodies, and of furnishing nuclei upon which phosphatic concretion may take place. Especially is this precaution necessary after a stone has been removed from the bladder.

Catheters employed for these and all purposes should be carefully sterilized, either by dry heat if metal instruments are used, or, if flexible, by immersing them in solutions of nitrate of silver, bichloride of mercury, or boracic acid. This is a precaution that it is well to take, though, on the other hand, we must all know instances where the individual has practised catheterism for a number of years with no other lubricant than his saliva. In elderly persons, particularly, the first introduction of the catheter should be accompanied by strict antiseptic precautions when this is possible. It is quite possible to understand how disastrous the sudden invasion of the bladder with bacteria may be.

Drainage of the Bladder.—Following upon the consideration of inflammation and suppuration within the bladder, it will be convenient to consider certain methods of drainage which are advantageously adopted in connection with the more chronic forms of these disorders. There are some bladders so shaped as to require treatment on precisely the same principles as are adopted in connection with the management of chronic abscesses. Bladder drainage may be effected by an opening above the pubes or through the perinæum. The former will be referred to when describing the operation of supra-pubic cystotomy. Perineal puncture of the membranous urethra for this purpose is most conveniently effected in the following manner:

The patient being placed in the lithotomy position, when under an anæsthetic, a centrally grooved staff is passed into the bladder. The correctness of the position of the instrument being verified by the finger in the rectum, the perinæum is punctured by a long finger knife entering in the median line one inch in front of the anus. The cutting side of the blade is directed toward the operator, while the point is made to penetrate the perinæum so as to enter the groove in the staff immediately in front of the apex of the prostate. The incision thus made is somewhat enlarged in a direction toward the scrotum, so as to admit with ease the index finger of the other hand. The latter is then introduced into the wound, and the staff felt for. If this has not been sufficiently bared as to be readily distinguishable to the touch, I clear the way by the use of a blunt knife made for this purpose; then a Wheelhouse's probe-pointed cone-shaped gorget is run along the groove in the staff so as to prepare the way for the finger which subsequently follows. The staff being withdrawn, a passage is now made into the bladder for the introduction of the draining-tube. Thus a tube exactly fitting the wound can be inserted without incurring risk of bleeding.

I will now notice some different kinds of drainage-tubes and the manner of their employment. Among the various means that are used in connection with the operative treatment of diseases of the urinary organs, the drainage-tube, in relation to the urine, probably occupies the most prominent position. It is, in fact, now identified with almost every procedure of importance. We see its use in connection with injuries of the urinary apparatus, more particularly in cases of rupture of the urethra, where the condition of the scar that follows is largely influenced by the kind of provision made for the disposal of the urine while repair is proceeding; in the treatment of several plastic operations on the urethra as well as the bladder; in the cure of chronic suppurative affections of the several parts constituting the urinary apparatus; in pouching and sacculation of the

bladder both with and without stone; and particularly in the prevention of some distinctive forms of fever originating in this system. In these as well as in other directions its use is now well recognized.

For introduction into the bladder through the perineal puncture, and retention in this position for the first forty-eight hours or so, I usually select a gum-elastic tube with a metal mount, having an opening on either side for the retaining tapes (Fig. 42). In calibre

Fig. 42.—Bladder Drainage Tube.

they are about as thick as my index finger, that is to say, they fit with some accuracy the opening they are intended for, though I generally have some of different sizes by me in case the wound may for any reason be somewhat larger than usual. Sometimes a suture is put into the perineal opening either above or below the tube, so as to make it fit accurately and prevent bleeding or oozing by the side. I use them in the same way after median cystotomy. They are not necessary after the lateral operation, except sometimes temporarily, to restrain hemorrhage by fitting the wound, as this incision into the bladder entails a condition of urinary incontinence for some days. These tubes should not be passed too far into the bladder, hence we should have at hand various lengths to suit different depths of perinæum. If the fit is accurate there should be no trouble with bleeding, or necessity for a ligature. A gum-elastic tube is preferable for the first forty-eight hours, as in case there should be any oozing we have something solid to plug upon. At the expiration of this period, a soft rubber one with a velvet or depressed eye, and open at the end is substituted, such as are made for me in different lengths and cali-

Fig. 43.—Soft-Rubber Drainage Tube for the Bladder.

bres by Messrs. Tiemann & Co., of New York (Fig. 43). The rubber drainage-tubes, with the punched-out eyes, are most objectionable. The mucous membrane of the bladder is liable to be sucked into them, and then, when they are withdrawn, pain and perhaps a little bleeding are occasioned by the sharp edge of the opening. This remark also applies to rubber catheters of all kinds. The soft tubes are

easily retained in position by a perineal band, to which they can be attached either by a safety-pin or tape. In some cases of extremely pouched or sacculated bladders, where the urine drained with some difficulty, I have used the two varieties in combination with advantage—that is to say, a soft rubber tube has been passed through a gum-elastic one, on the principle of the double tracheotomy tube. Where it has also been found necessary to wash out pockets in the bladder this has proved more effectual than the single tube. After the first forty-eight hours, whatever tube is used for drainage, the bladder should be washed out through it, and then the tube removed and changed. Care should always be taken, on replacing the tube finally, to test it with a syringe, and to see that it works accurately. For douching the bladder in connection with drainage-tubes nothing is better than a hydrostatic tank and a vulcanite tap at the end of the tubing, by which means the supply and force of whatever lotion is used can be regulated without producing any jar or sudden concussion. During the first forty-eight hours I usually let the urine drain into a pad of wood-wool or some antiseptic absorbent material which can be frequently changed. After this, when the flow is established, the patient may be kept quite dry by attaching a piece of rubber tubing to the metal nozzle of the drainage-tube, by which the urine is conveyed into some suitable receptacle between the patient's legs, or even outside the bed. No drainage can be perfect when the bed is of such a shape as to cause the patient to lie in a hole; the buttocks should be slightly elevated, and drainage favored by raising the head of the bed. The latter can easily be done by a brick or a wooden block. A little experience soon shows how all these details may be attended to, as much importance is attached to them. The length of time drainage should be carried on depends on the nature of the case. Where the urine, to commence with, is alkaline and ammoniacal or offensive, it will at all events be required until the excretion is discharged in a normal condition. I have tried other kinds of drainage-tubes, including those made of glass or of metal, but I find nothing so efficient as those I have mentioned.

There is a vulcanite tube with a movable collar described by Dr. F. S. Watson, of Boston, U. S. A. ("The Operative Treatment of the Enlarged Prostate"), which will be found useful in some cases where the bladder is much pouched behind a large prostate. The end of the instrument lies in this dip, and thus perfect drainage as well as provision for irrigation of this portion of the bladder are secured. By the movable collar the instrument can be at once adapted to any depth of perinæum.

Retention of Urine.

The bladder being the receptacle for urine, we may consider here the treatment of this condition so far as it relates to a more or less distended condition of the viscus as arising from an obstacle in front to the natural evacuation of the urine. These causes are for the most part prostatic and urethral, and under these headings will receive separate considerations. To empty the bladder in cases where catheterism is found to be impossible or inexpedient, various methods are employed, the routes being selected to avoid injuring the peritonæum.

Supra-Pubic Puncture or Paracentesis.—This is probably the best for the purpose of meeting an emergency of this kind. It consists in puncturing the distended viscus with a fine trocar and evacuating the urine with an aspirator.

In this operation there are two points to be remembered: (1) to use a fine needle only, and (2) to keep near to the bone, and so avoid puncturing the peritonæum. The line at which the reflection takes place is variable, but a space of at least half an inch usually exists above the pubes where the needle may be introduced with safety. This area is increased when the bladder is distended.

Where the chance of restoring the urethra is only remote, as in some chronic cases of stricture, Cock's operation of tapping the urethra at the apex of the prostate may be resorted to with advantage where urgent retention occurs. I occasionally see a patient upon whom I performed this operation many years ago. He had endured all the vicissitudes that could happen to the subject of a bad stricture, but since this operation he has enjoyed perfect health and comfort at the expense of micturating through the perinæum. Tapping the bladder from the rectum may now be regarded as an obsolete operation.

Tapping the Bladder through the Enlarged Prostate.—This is a method I described some years ago and which is practised in the following manner: The patient being placed in the lithotomy position, under ether, a specially made trocar with a silver cannula is introduced in the median line of the perinæum and pushed steadily through the prostate into the bladder while the left index finger is placed in the rectum to serve as a guide. The trocar is then withdrawn and the cannula, made for the purpose, is retained as a permanent vent. This proceeding has been followed by some excellent results, including shrinkage of the enlarged prostate where this condition has been the cause of the retention of urine. Commenting upon this method, the late Professor Gross remarks: "When the bladder is chronically inflamed, from enlargement of the prostate gland, tapping may be per-

formed through this organ, as was recently suggested and successfully practised by Mr. Reginald Harrison. My conviction is that this operation is destined to come into general use in this class of cases, of such frequent occurrence in advanced life, and a source of so much suffering" ("A System of Surgery," sixth edition, 1882, vol. ii., p. 703).

MALFORMATIONS AND STRUCTURAL ALTERATIONS IN THE FORM OF THE BLADDER.

Absence of the Bladder.

Complete absence of a bladder or of an independent receptacle for urine is occasionally though rarely met with, the ureters opening by the umbilicus, in the urethra or vagina, or into the rectum. Where the viscus has been entirely absent I am not aware of any attempts to construct one which have been sufficiently successful to deserve mention.

Double Bladders.

Two cavities—or more correctly speaking, bladders with a septum—have been described. A remarkable case of this kind is recorded by Dr. A. P. Smith, of Baltimore,[87] where, on examining the patient because of frequent micturition, it was discovered that he had a double penis with bladders to correspond, and his symptoms were explained by the presence of a stone in one of the receptacles which was successfully removed by lithotomy. Van Buren[88] describes a similar deformity.

Extroversion of the Bladder.

Among the most distressing deformities to which the human body is liable is that where the roof of the urethra is absent in conjunction with fission and extroversion of the bladder. No more deplorable condition can be imagined, for not only does the individual, more frequently of the male kind, possess sexual desire he is unable to gratify, but the function of micturition is carried on in such a way as to be a constant source of personal distress as well as of annoyance to others. Here not only are the parts fissured from the bladder downward, including the symphysis pubis, but the bladder presents the appearance of a fungating mass. The orifices of the ureters can generally be distinctly made out by the urine dropping from them, while the fissured penis projects at the base of the mass like a spout. The prostate is rudimentary. As already noticed, I can find no record of any male with this deformity who appears to have developed a large prostate. To remedy this condition various means have

been employed. Of these I would mention certain plastic operations, having for their object the closing in of the protruding bladder so as to form a receptacle for the urine and a covering for the parts. To the late Mr. John Wood [39] we are indebted for what has been done in this direction, and a reference should be made to his papers by any one undertaking an operation of this kind. Various plans have been tried, having for their object the diverting of the urine by a fistulous track into the rectum, but I do not know of any results thus obtained which would induce me to repeat these procedures. An article on this point, containing a number of experimental observations, has recently been published by Dr. R. H. Reed.[40] Mr. G. H. Makins [41] has recorded a case where, by means of a preliminary division of the sacro-iliac synchondrosis, he succeeded in diminishing the area above the pubes which required covering in by a subsequent plastic operation. Such a proceeding, however, can only be resorted to in early life, Professor Trendelenburg [42] placing the limit of age at five as being the most suitable. On reviewing what has thus been done for this class of deformities I am disposed to think that its relief will eventually work out most advantageously in the following way: By (1) the establishment of a lumbar fistula with one kidney, preferably the right one, and (2) the removal of the opposite kidney as soon as the urinary fistula has been rendered permanent. In this way the whole of the urine would be voided through one fistula, means being taken to collect the excretion as it escapes. Dr. Gross [43] refers to a case mentioned by Mr. Henry Morris, "where about ten ounces of urine were passed daily into a receiver adapted to the loin, the patient suffering neither inconvenience nor discomfort." After the formation of one permanent lumbar fistula, the bladder surface being no longer saturated with urine, it would, I believe, be comparatively easy not only to close in the protruding mucous surface, but further, under these altered conditions, to make a penis out of the fissured one which might permit of the performance of the sexual act. By the establishment of a single renal fistula in accordance with such a plan, or some modification of it, as I have endeavored to indicate, there seems some hope of ameliorating the state of persons suffering in this way. To collect the urine as it drops from the lumbar fistula, an apparatus such as Dr. Meyer [44] suggests, in the shape of "a bustle" as worn by ladies, might be employed. Of mechanical appliances for the relief of the deformity under consideration, I can speak favorably of an apparatus made by Messrs. Tiemann & Co., of New York. It consists of a metallic or hard-rubber shield for application over the exstrophied bladder, to the lower extremity of which an elastic tube is attached leading to a bag buckled to the thigh for collecting the urine.

Patent Urachus.

A urinous discharge from the navel is occasionally met with, and may be due to a patent condition of the urachus, a structure extending from the fundus of the bladder to the umbilicus, and retaining the tubular character of the allantois till about the thirtieth week of fœtal life. Subsequently it becomes obliterated and ceases at birth, except in some few instances, to have any tubular connection with the bladder. When the patency of the tube remains the patient is to all intents the subject of a urinary fistula in a position occasioning much inconvenience. To effect a closure of this opening various means have been employed, including the application of the cautery, and the vivifying of the walls of the sinus with the knife and the introduction of sutures. As in the treatment of other urinary fistulæ, the first thing to ascertain is that there is no mechanical obstacle to the escape of urine along the natural channel; care must be taken that this is not impeded in the male by a phimosis, a contracted meatus, or a urethral calculus, which are the commoner associations of a patent urachus. In the female it has been suggested that a condition of temporary incontinence of urine by over-dilatation of the urethra might be sufficient to bring about a cure.

Hernia of the Bladder.

Cystocele, or hernia of the bladder, is not commonly met with. Instances will be found recorded where the exploration of swellings and prominences in the region of the pubes, groins, and perinæum has proved them to be urine cavities, formed by hernial displacements of the bladder. Dr. Ernst Michels records the following case of extra-peritoneal vesical[43] hernia:

A man, aged 48 years, was admitted into the London German Hospital suffering from inguinal hernia on both sides. On the left side the radical operation was done without difficulty, but on the right it was more complicated. At last what appeared to be the empty sac was reached, isolated with some difficulty, and tied at its neck and cut away. The stump was put back into the abdomen and the inguinal ring closed. Twenty-four hours afterward the patient began to complain of pain in the hypogastrium, and the urine contained blood. It was evident now that what had been taken for and treated as an empty hernial sac was in reality an extra-peritoneal diverticulum of the bladder. The abdomen was opened at once, the bladder fully exposed, and a wound discovered in its peritoneal part which was closed by a double row of sutures. A rubber catheter was passed into the bladder and retained for six days. The patient made an uninterrupted recovery.

Mr. Crosse observes that persons suffering from cystocele in whatever form are very liable to calculus, and he mentions numerous instances of the sort.

Inversion of the Bladder.

There is a deformity in the female where the bladder becomes inverted, or turned inside out, and protrudes between the labia, as a vascular mass. In a case recorded by Mr. Crosse[4] the patient narrowly escaped the application of a ligature to the protrusion on the supposition that it was a nævus or vascular growth. Fortunately he was able to prevent the adoption of such a fatal course; for, as he remarks, "had a ligature been efficiently applied to the neck of the tumor, as was contemplated, the bladder would have been removed, including all its coverings, the ureters cut through just above their terminating orifices, and the peritoneal cavity largely opened." On examining this tumor, it was found capable of being reduced, like a hernia, by the pressure of the finger. When reduction was thus accomplished, a passage remained through which the tumor on retiring had taken its course, and which proved to be the dilated urethra. This reduction appears to have been effectual, for Mr. Crosse remarks: "During the short time the patient remained under my notice there was no relapse, and I am enabled to add that she is still living, after an interval of sixteen years, and is a healthy young woman, save only the affliction of incontinence of urine, with which she has been constantly troubled, but without any relapse of the vesical displacement."

Hypertrophy of the Bladder.

The increased growth of the muscular coat of the bladder, as the term implies, is a natural consequence arising out of obstructed micturition, as is best exemplified in connection with urethral stricture and certain forms of prostatic obstruction. It cannot, therefore, in this sense be regarded as a disease. The growth, however, by limiting the capacity of the bladder, is usually accompanied by frequent micturition, a circumstance which sometimes leads to the cause of the hypertrophy being overlooked. There is a condition which has been described as a columniform state of the bladder, in which the interior presents an appearance not unlike that of the ventricles of the heart, the muscular fibres not being spread out uniformly but being collected in bundles like the columnæ carneæ. In this way depressions are formed within the interior of the bladder which may eventually develop into saccules or form receptacles in which small calculi from the kidney may be readily concealed.

Atony of the Bladder.

This is a term which is generally used to indicate the inability of the viscus to void its contents in a natural manner. It is most frequently met with in connection with prostatic obstruction and occasionally as a consequence of neglected organic urethral stricture in the adult male. In the majority of instances the cause is purely mechanical, that is to say, if the obstruction can be removed, the full power of the bladder may return even after very considerable periods of inaction. The subject of atony is best discussed in connection with the co-existing circumstances just mentioned.

Sacculation and Pouching of the Bladder.

Pressure on the walls of a reservoir like the bladder is capable of causing certain alterations in the form of the viscus to which the terms, (1) sacculation and (2) pouching, have with some indiscrimination been applied.

By *sacculation* is understood that a limited portion of the vesical mucous membrane becomes herniated or prolapsed through the interstices of the muscular network surrounding it, and thus independent sacs of various shapes and dimensions are produced. Sacculations of the bladder may occur at almost any point, they may be intra- or extra-peritoneal, they are met with at all periods of life from birth onward, they have little or no independent means of exercising power over their contents as by contraction of their walls, and they are capable of being called into existence and of being disposed of in ways not unlike those which are more commonly illustrated by intestinal hernia. The causes of sacculation may be ranged under three headings: (1) intra-uterine, (2) arising from obstacles to micturition within either the prostate or the urethra, and (3) traumatic. As Mr. Targett has recently pointed out,[1] some sacculations are of a congenital nature and are explainable either as consequences of intra-uterine pressure or of developmental variations. The most frequent causes are, however, those which are included under the second heading as arising from the pressure exercised in overcoming an obstacle in front of the bladder. This can be readily understood, especially when, as is often the case, the muscular coat of the bladder is more or less hypertrophied. Traumatic causes leading to a sudden compression of a distended bladder have in some instances which have come under my observation led to a similar consequence.

The diagnosis of sacculation is not always made. In some in-

stances we have nothing to guide us but the fact that the movement of a catheter, preferably a soft one, may unmistakably indicate the existence within the area of the bladder of more than one distinct reservoir for urine. In one or two instances not only was I able to recognize the probability of a sac in this way, but there was a marked difference in the appearance of the sample of urine removed from the two compartments. Guthrie,[18] to whom we are indebted for a description of this condition, observes: "In one gentleman the existence of one or more pouches of this kind became evident on injecting the bladder; twelve ounces of warm water could be thrown into it before much uneasiness was produced, but on drawing it off ten ounces only could be obtained, and rarely the whole twelve even by change of position." Careful examination of the contiguous parts about the bladder may sometimes tend to the detection of sacculation. The size of these diverticula is sometimes so considerable and the direction they take so unusual that in investigating growths and swellings in the neighborhood of the pelvis we should not forget to test the state of the bladder by the preliminary use of a catheter. A pelvic tumor has in this way been made to disappear. The presence of these sacs often occasions serious inconvenience to the patient and embarrassment to the surgeon. They are spaces in which urine collects and decomposes, not infrequently calculi descending from the kidney are trapped and concealed by them, and in some instances by retaining sharp fragments of stone after lithotrity they have contributed to the production of a fatal cystitis. It must not be forgotten that these pouches, either by impaction with calculous matter or by decomposition of the urine for which they are the receptacles, may undergo acute suppurative inflammation and by bursting within the pelvis occasion a most serious cellulitis.

Saccules most frequently come into prominence as complications in connection with other disorders. Of these I may mention stone, enlargement of the prostate, and cystitis. Calculi in the bladder thus complicated represent a state of affairs where, as a rule, the stone should be removed by a supra-pubic cystotomy and the sacculation dealt with by drainage. This is obvious not only for the reason that the latter may render a complete lithotrity impossible, but that, by retaining fragments and keeping up cystitis, they favor the speedy reformation of the stone. To determine the presence of a sacculus in the bladder where there are sufficient grounds to demand this, and with the object of treating it and bringing about its contraction by drainage, if its removal is found to be impossible, exploration of the bladder by the supra-pubic route might with advantage be oftener resorted to.

By *pouching* of the bladder (Fig. 44) is understood that a depression is formed in the most dependent portion of the viscus in which the whole thickness of the wall is involved. It is for the most part met with in the senile adult bladder in connection with hypertrophy of the prostate and occasionally as a consequence of the pressure exercised by the presence of a stone. Mr. Buckston Browne[49] has illustrated how such a pouch may be the means of containing as well as concealing one or more stones. These pouches, when complicated with calculus and an enlarged prostate, not infrequently render the selection of lithotomy a necessity. A pouch that has once held a stone for some time is seldom fitted to hold anything else, and consequently an attempt should be made to dispose of it by some adequate form of bladder drainage. In the general treatment of pouching and sacculation of the bladder, when not complicated with stone, I must add my testimony to the great benefit that has sometimes followed sea-voyages. I have known thick cystitic urine, due to the pollution of the general cavity of the bladder by the contents of a stagnant sac, entirely recover itself when placed under these conditions. The constant movement of the ship both by day and night, and in whatever position the body may occupy, renders stasis of any of the fluids of the body impossible, and thus one element necessary for decomposition is removed. The immunity of seamen from stone and certain bladder affections may in some measure be due to this.[50] In one instance at present under my observation where there is very little doubt the patient has a sacculated bladder, the urine is invariably clear and normal when he is at sea, and turbid and offensive when he is on shore for any length of time. Yet in other respects, as far as I can judge, the conditions are the same.

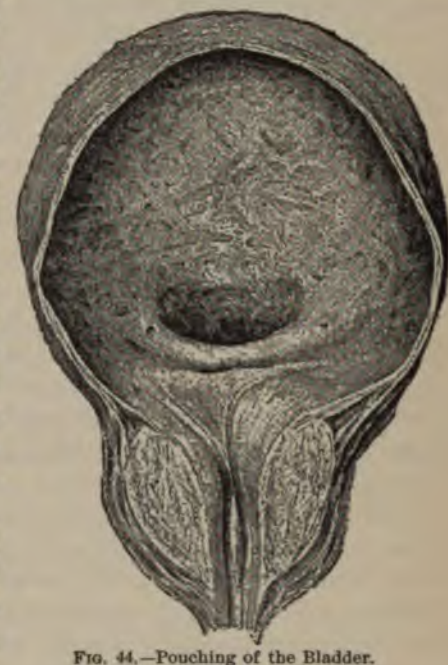


FIG. 44.—Pouching of the Bladder.

Tumors of the Bladder.

The bladder wall is developed partly from hypoblast and partly from mesoblast; consequently, on the embryological theory of the origin of morbid growths, we may expect to find connective-tissue, vascular, and epithelial tumors. It is interesting to note, in association with papilloma of the bladder, that the allantois, the hypoblast lining of which gives rise to the epithelial coating of the bladder, is also the source of the chorionic villi, the most perfect example of physiological papillary growths. The classification of bladder and prostate tumors adopted here is similar to that proposed by Mr. Paul,[51] in a paper read before the British Medical Association in 1883. The former will be considered in the following order: (1) Myoma; (2) Fibroma; (3) Myxoma; (4) Sarcoma; (5) Papilloma; (6) Carcinoma.

(1) *Myoma* of the bladder is a very rare growth, met with chiefly in the form of nodules encapsuled in the submucosa. It is composed of unstriped muscular fibres, resembling uterine or prostatic myoma. Cases are recorded by Gussenbauer[52] and Volkmann.[53] The muscular fibres are sometimes mixed with a good deal of fibrous tissue, when the tumor is called a fibro-myoma.

(2) *Fibroma* and (3) *myxoma* may be regarded as essentially the same, myxoma being merely a fibroma, the cell substance of which has undergone mucoid transformation. The great majority of these growths, which are by no means common, are polypoid, and the softer varieties approach very closely in structure the denser papillary growths. A true fibroma, however, would originate in the deeper layers of the submucosa or muscular coat, and be covered by the distended but otherwise normal epithelial layer; whereas in a papilloma the essentially epithelial character of the growth is evident from the large share taken by the epithelium in its formation. Fibromata and myxomata constitute the majority of so-called bladder polypi. The former occur in adults, and the latter usually in young children, in whom they are probably generally congenital.

(4) *Sarcoma* of the bladder is less frequent than carcinoma. The round-celled variety is the form in which it usually occurs. Mr. Paul, in the paper before quoted, mentions but one specimen, the same described by Mr. Rodger Williams.[54] This growth occurred in a hernial sacculus of the bladder, and was composed of round and spindle cells. It was believed to be a sarcoma which had become inflamed. Two cases of lympho-sarcoma of the bladder have been described by Mr. Eve and Mr. Chaffey,[55] and the former in the same communication also gives an account of a mixed or myo-sarcoma occurring in the

muscular coat of the bladder. The lympho-sarcoma is composed of a fine fibrous stroma, the meshes of which are occupied by round cells with large, deeply staining nuclei and very scanty cell protoplasm. Sarcomas of the bladder may be very small, scarcely showing on the surface, or, as in Mr. Eve's case, they may form large masses projecting into and partly filling the bladder; the surface may be ulcerated, but is apparently, unlike that of carcinoma, never villous.

(5) *Papilloma.*—As the mucous membrane of the bladder is destitute of papillæ, the term papilloma, as applied to innocent villous growths of this viscus, has been objected to, many pathologists holding with Virchow[56] that they should be termed vascular papillomatous fibroma. As the papillary outgrowths are, however, clothed by a very thick layer of epithelium, and as it can be seen, as was first pointed out by Rindfleisch,[57] that in the more delicate of the villous tufts the basement membrane of the epithelium rests on the wall of the blood-vessel without the intervention of any fibrous tissue, it may be said that, although many villous tumors partake to a greater or less extent of the characters of a papillation of a fibrous growth, they are mostly best described as true papilloma; and in this connection it is well to recollect, as already mentioned, that the extra-abdominal portion of the allantois which forms the chorion is normally provided with papillæ, hence it is not an unlikely occurrence for them to be met with in the bladder (the intra-abdominal portion of the allantois) as a pathological occurrence.

Papilloma or villous tumor (sometimes incorrectly called villous cancer of the bladder) is met with chiefly on the trigone and in the neighborhood of the ureters; in other words, like warty growths in other situations, around the orifices. It is composed of numerous long, filamentous, branching processes, forming a cauliflower-like growth of a variable consistency depending on the amount of connective-tissue framework supporting the epithelial growth and vessels. On microscopic examination the processes are seen to be more or less made up of a delicate fibrous stroma, containing thin-walled and wide —sometimes varicose—blood-vessels, and not rarely unstriped muscle cells, the whole forming an upward prolongation of the submucosa, covered with stratified epithelium. The growth does not extend into the deeper layers of the mucous membrane, and the epithelium everywhere rests on a basement membrane. While the growth retains this structure it is in no sense malignant or cancerous, but papilloma here as elsewhere is liable, if not removed, or if recurring after removal, to grow more and more dense and fleshy in character, and ultimately to become a carcinoma. This is well illustrated in a case related by Mr. Paul, where a papilloma which had been removed several times

ultimately caused the death of the patient, after ten years of occasional treatment, and the growth was then found to be infiltrating the bladder wall as a carcinoma. It is to be remembered that where a papilloma overlies a carcinomatous growth in the submucous and muscular coats of the bladder, this condition does not necessarily depend on the innocent growth having taken on malignant characters, since it is not very rare to find, as is well shown by Cornil and Reliquet, that carcinoma may be associated with the development on the overlying surface of a structurally innocent papilloma.

The delicate and friable character of a villous tumor renders it very liable to injury from the contraction of the bladder in emptying itself, not only by the action of friction and pressure on the growth, but also by the congestion of the capillary loops produced by the contraction of the muscular coat. In this way hemorrhages are frequent, and death is usually due to anæmia and exhaustion. In other cases the position of the growths around the ureter leads to chronic obstruction of that tube and hydronephrosis. In some instances where the obstruction is more acute, suppurative pyelonephritis may result. The papillomas of the bladder are subdivided into two classes, fimbriated papilloma and fibro-papilloma. In the former the stalk breaks up into numerous delicate branches presenting the well-known villous appearance; in the latter it is compact and sessile, and has a more dense fibrous structure.

(6) *Carcinoma.*—The epithelial lining of the bladder is composed of a single surface-layer of large-sized squamous cells, with underlying pear-shaped and round-cell layers. It is also provided with small racemose mucous glands, most numerous near the neck of the bladder. It will be seen that we may thus expect to meet with two varieties of cancer of the bladder: (*a*) epithelioma, or squamous-celled carcinoma, and (*b*) glandular-celled carcinoma. Speaking clinically, the former would usually be termed encephaloid cancer, while the latter might be encephaloid or scirrhus—in other words, soft or hard. These clinical terms, however, give no information relative to the intimate structure of the tumor, but indicate only its rapidity of growth and probable degree of malignancy. The vesical glands might be liable to innocent adenoma as well as to malignant carcinoma. So far as I know only one case of the former is recorded, viz., a case of papillary adenoma, removed by Kaltenbach[58] from the bladder of a woman aged forty-four years.

Dr. J. H. Neale, of Leicester, records a case[59] of malignant tumor of the bladder where the account of the microscopical features of the growths, to which he gives the name of adeno-encephaloid cancer, indicates a glandular as distinct from a squamous epithelial origin for

the growth. The ordinary epithelioma of the bladder is a growth of variable size and extent, either limited to one spot from which it spreads, or diffuse, occurring in a variable number of patches, one usually showing evidence of being the primary growth. The tumor is not encapsuled, but infiltrates the submucous and muscular layers, spreading to the peritonæum, the bowel, the prostate, or even extending to the perinæum, where it forms a fungating mass. This latter is liable to occur in cases where the growth has been partially removed from the bladder after perineal section, the cancer invading the granulation tissue of the wound, and spreading along it to the surface.

The mucous membrane over the growth may be ulcerated and fungous, or covered with papillary excrescences, showing no outward evidence of malignancy, or even quite smooth and apparently unaltered, in the smaller patches. The stroma of the growth, composed of the tissue of the submucous and muscular layers, with more or less round-cell infiltration, is full of alveoli well packed with epithelial cells, following, with more or less accuracy, the types of the bladder epithelium. Psorosperms have been met with in the epithelial cells, and by some are regarded as the cause of the malignant growth. They are described and figured by Albarran in his work on tumors of the bladder ("Les Tumeurs de la Vessie," Paris, 1892). The formation of "cell nests" varies much in different specimens and even in different parts of the same specimen. Colloid degeneration may occur in primary carcinoma of the bladder, but is by no means common.

Secondary Carcinoma.—Secondary cancer of the bladder is much more common than primary cancer. It is usually due to direct invasion of the bladder wall by growths originating in the prostate, rectum, or uterus. In either case the growth infiltrates the bladder wall, and may cause symptoms such as vesical tenesmus and hæmaturia, or it may interfere with the flow of urine into or from the bladder, with corresponding symptoms. Indications of the previous existence of the primary growths are not, as a rule, wanting. The structure of the secondary growth is, of course, a repetition of that of the primary one.

Enchondroma.—Two cases of enchondroma of the bladder have been described,[80] but in neither case does the description render it other than doubtful that the growths had their origin in that viscus. A case of vesical angioma is described by Langhans.[81]

Cysts of the Bladder.—Serous, hyatid,[82] and dermoid cysts of the bladder are occasionally met with. Serous cysts may be due to softening of a myoma, or they may be simply cysts formed in the mucous membrane. Hydatid cysts may occur in the bladder wall or its

immediate neighborhood as elsewhere. Cases are from time to time recorded where hairs have been passed in the urine. In some cases the hairs doubtless came from dermoid cysts of the ovary which had ruptured into the bladder, but in others they have unquestionably originated in true vesical dermoid cysts, or, as in Martini's case,[63] from a patch of true skin bearing hair follicles and forming part of the bladder wall. Such an occurrence would depend upon a developmental aberration, by which a portion of the bladder wall had been formed by the ingrowth of epiblast to make up for some deficiency in the hypoblast.

Bilobed and pouched bladders[64] and hernial saccular protrusions of the mucosa need only be named here. Cysts of the urachus are not very infrequent.

The presence of the bilharzia hæmatobia sometimes leads to the formation within the bladder of fungating masses of exudating tissue, attended with profuse hæmaturia, which have called for operative procedures for their relief.

Tumors of the Prostate.

As the prostate is composed of fibrous, muscular (unstriated), and epithelium-lined gland tissue, we may expect to meet with connective-tissue tumors, myoma, adenoma, and carcinoma, and these we find to be the new growths of this part.

Myoma.—Unstriated muscular tumors of the prostate are met with as small encapsulated growths, most frequent in the so-called middle lobe, or as large masses apparently involving the whole part. Such a case was Mr. Spanton's,[65] where a mass of growth the size of a fist was removed by operation, and a further equally large mass was found at the autopsy. It closely resembled that of a moderately soft uterine myoma, and in this connection the developmental identity of the female uterus with the male sinus pocularis and its immediately surrounding muscular fibre is to be noted. Pure myoma of the prostate is a rare growth. The encapsuled tumors usually contain a considerable admixture of glandular tissue, and are properly called adeno-myoma. They correspond to the adeno-fibroma so frequently met with in the female breast.

Sarcoma of the prostate would appear to be the form of new growth most frequently met with in this part. In structure it may be round- or spindle-celled, or, as is frequently the case in the bladder, a lympho-sarcoma.

Carcinoma of the prostate is either tubular or acinous, and, in either case, may become colloid. Sections of it show a stroma com-

posed mainly of unstriated muscular fibre, containing alveoli filled with cells resembling those of the prostatic glands.

Primary carcinoma of the prostate is not of such rare occurrence as is generally supposed. It is frequently overlooked, both during life and after death, any enlargement or induration being regarded as merely ordinary hypertrophy. In several instances which I have seen, where the diagnosis was verified by microscopical examination, the disease was marked by slow progress and by the slightness of the local symptoms that were present throughout. It appeared to prove fatal by the general decay that was induced, rather than by any interference it occasioned, directly or indirectly, with the function of micturition, thus contrasting with advancing forms of ordinary prostatic hypertrophy. The following case seems to illustrate this:

CASE.—I frequently saw a gentleman, aged 59, in 1884, who suffered from irritability of the bladder, which he could not completely empty. He was losing flesh, becoming pale, and, though the mental faculties remained vigorous to the last, he constantly complained of pain in the loins, nates, and thighs. In the course of a few weeks he became entirely dependent upon the catheter. His prostate was hard, nodular, and almost insensitive to the touch, though no glands in the neighborhood were involved. As his general health slowly declined, minute petechial spots appeared on various parts of his body, and his feebleness gradually increased. Occasionally he passed a small quantity of blood with his urine. He appeared to die of exhaustion, the result of prolonged blood-vitiation. After death his prostate was examined and found to be an unmistakable example of carcinoma. There was no evidence to show that this was other than the primary disease.

Mr. Bryant [66] has recorded a case of fibrous polypus of the prostatic portion of the urethra, associated with profuse hæmaturia and prostatic enlargement, where, on exploration by a median perineal operation, a polypus the size of a haricot bean was removed. After a somewhat tedious convalescence recovery ensued, and eighteen months after the operation the patient was well, with his prostate contracted to its original size.

The prostate is frequently the seat of small calcareous deposits, which have been described under the name of prostatic calculi. They probably represent a concreted state of the natural secretion of the prostatic glands.

Tubercle of the prostate, which is first miliary and then caseous, may be mistaken for new growth if care be not taken to exclude it on clinical grounds. It is, as a rule, secondary to tubercle of the kidney and bladder or of the testicle, most frequently the latter. Prostatic cysts may be either retention cysts of the prostatic follicles, or, what

is more usual, urethral diverticula, as in a case recorded by Mr. W. Arbuthnot Lane.[67]

Some growths involving the urethra have been already referred to in connection with malignant or cancerous strictures. Polypi of an innocent kind are sometimes met with in this position. Mr. W. H. Brown [68] records an instance which is unique:

Case.—The patient, a male, aged 18, was under observation during 1891, for difficult and painful micturition. The pain was referred to the end of the penis, and there was frequent incontinence at night and dribbling of the urine when walking about. On one occasion, whilst straining to urinate, about two ounces of bright blood were expelled. On his attempting to pass urine the stream was very small, and a curious balloon-shaped swelling just over the urethra at the junction of the penis with the scrotum was observed. The urine was natural. The boy died of extensive cystic disease of the kidneys. The growth in appearance resembled a polypus and was attached behind to the prostatic region in the posterior wall of the bladder, and in front to the urethra as shown in the drawing (Fig. 45). Mr. Brown observes: "I have not been able to find a similar record. The position of the tumor and its twofold attachment are, so far as I know, without parallel."

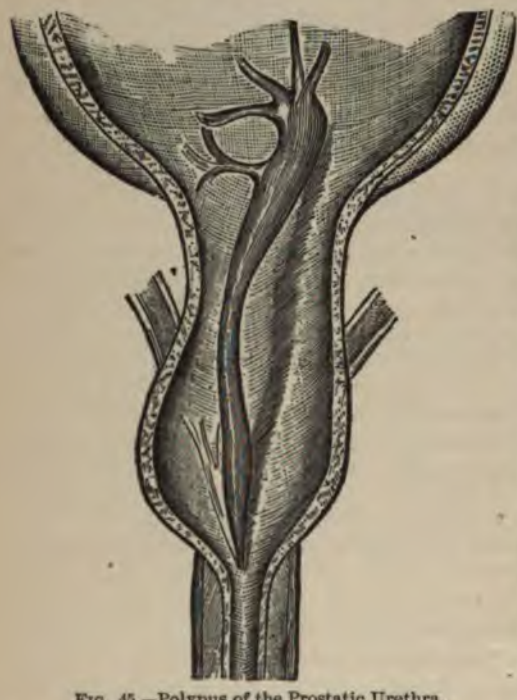


Fig. 45.—Polypus of the Prostatic Urethra.

Treatment of Tumors of the Bladder and Prostate.

For clinical purposes relative to treatment it will be convenient to consider tumors of the bladder as they are usually presented to our notice. We can recognize three periods in the existence of many of these growths, irrespective of the question of degree of malignancy or otherwise, which, though not defined by any artificial lines, are sufficiently distinctive for the object in view. These stages may be spoken of as (1) quiescent; (2) symptomatic; (3) destructive. I

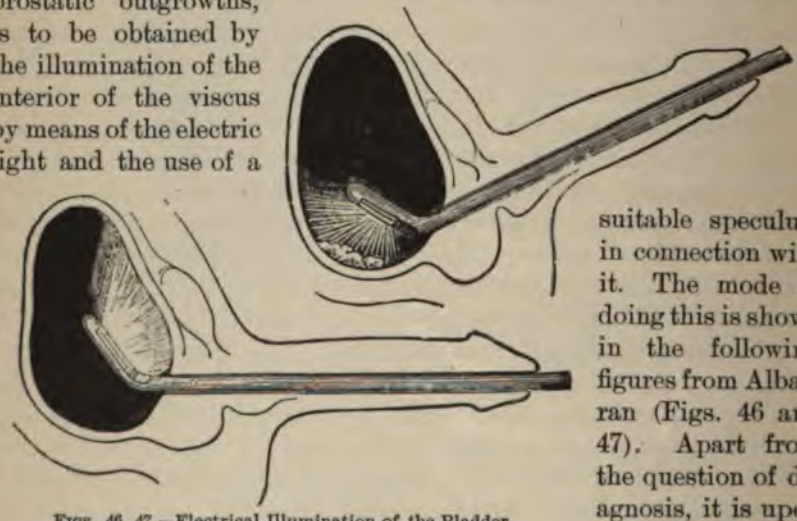
must not, however, be understood to imply by this that all growths pursue the several courses I have thus indicated. Some, so far as we know, are quiescent throughout, being only accidentally discovered either during life or after death; others terminate existence by the symptoms they produce rather than by any morbid characteristics they inherently possess; while a third group, like cancerous affections, are fatal by the tissue destruction they directly effect, and the consequences on the system generally arising out of this. With this reservation the grouping suggested for clinical purposes may suffice.

1. *The Quiescent Stage.*—This includes the early stages of growths, where they proceed up to a certain point without giving any specific indication of their presence. Some of the innocent tumors of the bladder have thus remained during the whole period of their existence, instances having been recorded where they were casually discovered by the electric cystoscope. Other examples have been found in autopsies where no distinctive history appeared to have been connected with them, and cases are known in patients of the total cessation, after varying periods, of symptoms which seemed to be those connected with villous growths or papillomata. Whether their disappearance was due to an inflammatory act within the bladder or to sloughing it is impossible to say, but such an occasional termination is sufficiently well authenticated for acceptance. The evidence that a person has a tumor in his bladder would not alone, in the absence of other reasons, warrant operative measures being taken for its removal. Nor does the persistence of a single symptom—such, for instance, as occasional hæmaturia without causing detriment to the general health—justify the performance of an operation involving the opening of the bladder merely on the presumption that some growth exists within the area of this viscus or of the prostate. Some prostates which are enlarged occasionally bleed just as a hæmorrhoid will do, and with as little harm, and pieces of prostatic hypertrophies have occasionally been removed as growths or tumors with, I believe, insufficient reason.

2. *The Symptomatic Stage.*—The larger proportion of bladder tumors sooner or later pass out of the quiescent condition, and enter upon the second or more active stage of their existence. Whether this transition is slow or rapid, gradual or sudden, greatly depends on their kind as well as on the accidents and contingencies connected with their growth; but whether innocent or malignant, primary or secondary, the majority of them sooner or later make it apparent that life will eventually be destroyed, either by persistent hemorrhage or ulceration, or by the degree of interference with micturition. Continuous or intermittent hemorrhage, evidence of ulceration, and inter-

ference with micturition are the symptoms of progressive tumor of the bladder which may be sufficient to indicate operative interference. In addition, valuable assistance in diagnosis can generally be obtained by examination of the bladder from the rectum and with the sound, and by the evidence that may be furnished by an inspection of the growth. By the rectum the finger will frequently prove that the posterior wall of the bladder, as well as the contiguous portion of the bowel or prostate, is implicated in a growth of an irregular form and consistence, partaking of the characteristics usually associated with the physical signs of malignancy. Exploration with the sound will often also unmistakably indicate that the area of the bladder is more or less encroached upon by a new tissue formation, which as a rule readily bleeds, even under delicate manipulation. Direct evidence is sometimes afforded by the microscopical examination of portions of growth voluntarily discharged during micturition or removed in the eye of a catheter or by any other instrument. Too much importance must not be attached to this, in the absence of symptoms of a corroborative nature.

In the present day the most reliable evidence of the presence and nature of a tumor within the bladder, including some varieties of prostatic outgrowths, is to be obtained by the illumination of the interior of the viscus by means of the electric light and the use of a suitable speculum in connection with it. The mode of doing this is shown in the following figures from Albarran (Figs. 46 and 47). Apart from the question of diagnosis, it is upon an examination of this kind, taken in conjunction with the symptoms each case presents, that conclusions as to treatment, more particularly in reference to operative measures, are to be drawn and a course decided upon. Ocular inspection obtained in this way has now almost entirely superseded the digital explorations which were practised before the intro-



FIGS. 46, 47.—Electrical Illumination of the Bladder.

duction and perfecting of this means of diagnosis. It is for these reasons that attention may here be drawn most conveniently to electric cystoscopy. For its general application to local states of urinary disturbance reference should be made to special works upon this subject, among which I may mention those of my colleague, Mr. Hurry Fenwick,[69] as containing the fullest information, and as furnishing the most practical guide to all matters relating to it. I have already indicated the symptoms which would suggest the presence of a growth within the bladder, and the necessity for proceeding to an examination of this kind.

For this purpose I have been in the habit of using Leiter's instruments. As a rule it is best to have the patient placed under an anæsthetic, and in the lithotomy position at the end of an operating table of a suitable height. A deep injection of a ten-per-cent solution of cocaine in some cases suffices to render the examination painless. The following requirements, as stated by Mr. Fenwick, are necessary for success: "(1) The urethral canal must have a calibre of twenty-two French catheter gauge. (2) The bladder must have a capacity of at least four ounces. (3) The water in the bladder must be translucent, and ought to be perfectly transparent." The last condition is probably the most difficult to obtain in cases of growth, and requires some patience and aptitude in the preliminary irrigation of the bladder. Washing out with equal parts of extract of witch hazel and hot water will often render the urine clear of blood.

The kind of vesical growth and the possibility of its complete or partial removal may in this way be determined with much accuracy. In some forms of pendulous, grape-like, and simple papilloma removal may usually be undertaken with the prospect of permanent success, while in diffuse villous carcinomata of considerable extent, operative measures can do no more than palliate symptoms arising from constant hemorrhage and obstruction to micturition, as well as from the tension produced by the pressure of the growth on the wall of the bladder. Hence the growths that are most accessible to operative treatment are those belonging to the former variety. Their diagnosis is tolerably easy; they are usually situated at the most accessible part of the bladder, namely, at the orifice of a ureter, and when removed, as I have had frequent occasion to note, they do not recur. On the other hand, the carcinomata and semi-malignant growths of the bladder, so far as their removal by operation is concerned, in no way differ from what is observed, in this respect, in connection with similar tumors situated in other parts of the body.

I have opened the bladder in some cases by the supra-pubic and in others by the perineal method, though the former is to be pre-

ferred, on the same principle that the intestine is sometimes opened and an artificial anus formed to relieve the obstruction and distress which is occasioned by a cancer situated lower down the intestinal canal. On grounds such as these, a supra-pubic opening for drainage, and as a substitute for the long and narrow channel of the natural urethra, is to be recommended when the nature of the symptoms demands it by reason of the bladder being obstructed by a more or less fungating cancer. In the following case the relief afforded by operation was marked and continuous as long as the patient lived:

CASE.—A male patient, aged 66, whom I saw toward the end of 1892, had been suffering from vesical hemorrhage for many months previously. The bleeding, retention of urine and clots, and the pain from tension had become so constant and unmanageable as to indicate the necessity for adopting other means, as all medicines as well as catheterism and irrigation of the bladder had proved useless. I advised a supra-pubic opening, which I made shortly after I first saw the patient, and removed portions of a carcinomatous growth from a hard base immediately above the prostate. The relief was complete, the growth was checked, and the hemorrhage was only slight and occasional. The interior of the bladder was rendered clean and aseptic by passing a soft catheter each day along the urethra and washing out through the wound. The urine was discharged by the opening, and the patient kept dry by means of wood-wool pads. He was enabled to get about again, and remained free from pain until a fortnight before his death, five months afterward.

When it is determined to operate for the removal of a tumor within the bladder, with the object of either cure or relief, supra-pubic cystotomy, as described later on, is on all grounds to be recommended. If the connections of the tumor are extensive, and there is a doubt as to whether all can be got away without doing serious damage to the bladder itself, I feel sure that we had better content ourselves with the opening, which may under all circumstances be safely made, and the drainage with a suitable apparatus that this aperture will provide. The lesser proceeding has in many instances proved the means of arresting hemorrhage, and of adding materially to the comfort as well as to the life of the patient, even where it has been found impossible either to remove the tumor or with safety to reduce its size. And what relates to the male is equally applicable to the female, though with the latter, by reason of the anatomical differences in the parts, both exploration and removal can be more readily effected. It must not be overlooked that in some cases of malignant tumor of the bladder which have been operated upon, recurrence has taken place in the wound. Dr. J. H. Neale [70] records an instance of adeno-encephaloid cancer of the bladder, operated on by Mr. C. H.

Marriott, where the wound and the perinæum adjoining were subsequently largely invaded by the growth. Mr. Marriott remarks: "This case alone appears to me to put a limit to the range of surgical treatment of vesical tumors. Where a polypoid or pedunculated growth is diagnosed, by all means remove it; but in the case of a sessile tumor, closely incorporated with the muscular walls of the bladder, the treatment best suited to the requirements of the case seems to me to be to establish and maintain free drainage and so relieve the strangury, leaving the tumor to take its own course." In this expression of opinion most surgeons of experience, I think, will agree.

Some cases of partial resection of the bladder wall containing a growth have been recorded by Albarran and others, but this method of treatment has so far not proved to be practicable except to such a limited extent as hardly to require special notice.

In malignant growths involving the bladder, which are considered as being outside the pale of operative treatment, the question arises, can anything be done either to check their progress or to avert the blood deterioration which becomes evident? For these purposes iodide of potassium and Chian turpentine have sometimes been used with apparent temporary advantage. The former certainly does occasionally check the growth and extension of neoplasms, while the latter has been known to do more, as stated by the late Mr. Clay, when given in malignant growths involving more particularly the urinary passages. The therapeutic effects of Chian turpentine may possibly be due to some of the constituents of the drug being eliminated by the urine, and this may also explain its efficacy, undoubtedly observed in some instances, in controlling hemorrhage and rendering the absorption of cast-off products of inflammation less deleterious.

3. *The Destructive Stage.*—The last phase of malignant growth within the bladder may be the inclusion of other parts, such as the intestines, and the formation of a fistulous communication between these two cavities. The symptoms attending such a termination are generally of a most distressing nature, due to the intermixture of fæces and urine. Though colotomy cannot be performed for malignant perforations with the hope of obtaining a permanent cure, it is often to be recommended as a means of arresting pain and prolonging life.

The functions of the bladder may be seriously interfered with by the growth of tumors having origin in other organs or parts, such as the uterus and ovaries in the female, and in the contents of the pelvis generally, including growths springing from the pelvis. These occasionally fungate into the bladder by ulceration through it, and thus cause hæmaturia.

It will not be necessary to make special reference to the operative treatment of tumors of the prostate. Most of these are inseparably connected with the bladder, and but little can be done by operation. When the catheter fails to relieve pain and the distress and spasm which the retention of urine and blood-clots is capable of causing, the propriety of a supra-pubic or perineal incision for exploration, drainage, and, if found feasible, extirpation of the part, may then be considered.

Endemic Hæmaturia.

This term is applied to forms of hæmaturia chiefly met with in tropical countries, and is dependent upon the presence of a parasite. The *Bilharzia hæmatobia* was first discovered in the portal vessels of man in 1851, by Dr. Bilharz, of Cairo, after whom Cobbold subsequently named the parasite. In 1864, Dr. John Harley discovered the ova of the worm in the urine of a patient from the Cape of Good Hope. Subsequent investigations have shown that this parasite has a wide area of distribution in Africa, where it affects men and apes, and, to a less extent, sheep and oxen. The diseases of man dependent on its presence are a certain proportion of the cases of chronic endemic Egyptian dysentery, the majority of cases of endemic hæmaturia of Egypt, Natal, and the Cape, and also, in all probability, the endemic hæmaturia of the Mauritius.

This parasite is a unisexual trematode worm; the male, about half an inch in length and rather flattened, acquires a cylindrical appearance from the thinned lateral margins of the body being infolded ventrally so as to overlap and form a sort of channel (the gynæcophoric canal) for the reception of the female during and after copulation. The female is longer and thinner than the male, and quite cylindrical. The eggs are oval, about $\frac{1}{160}$th of an inch in length, and pointed at one end, which is armed with a short, sharp, spine terminal in position when the ova are lodged in the urinary passages, but lateral when they lie in the mucosa of the bowel (Zancarol). The outer layer of the ovum is a tough, hard shell of keratin; inside this the yolk segments and develops into a ciliated embryo, the shell is ruptured, and the now free swimming ciliated trematode probably passes into the body of some intermediate host belonging to the snail tribe, where it changes into a *cercaria*, to be subsequently again acquired by man through the medium of stagnant drinking-water. The cercaria stage and its host are unknown.

I am indebted to Sir W. Roberts for the plate illustrating bilharzia in urine from a case which he had an opportunity of seeing in the Manchester Infirmary (Fig. 48). The patient was a groom, aged nine-

teen, in the service of the Viceroy of Egypt, and had been in the habit of drinking unfiltered Nile water, and of eating watercress freely.

In man, the adult male and female worms reside, in a few cases, in the vena cava inferior and its tributaries, but the true home of the

FIG. 48.—Bilharzia in Urine. 1. Free embryos, showing the different shapes they assume as they swim about in the urine. 2. Ova containing unhatched embryos. 3. Empty shells from which the ova have escaped.

parasite is in the portal vein and its numerous tributaries. Kartalis has counted three hundred, mostly in sexual pairs, in the portal system of a single case. The parasites, after impregnation, are to be found in largest numbers in the submucosa of the bladder, ureter, renal pelvis, and rectum. Here, lying in large smooth-walled spaces, which are dilated blood-vessels, the female deposits her eggs, which pass on to the surface of the mucosa, possibly by the boring action of their spines, assisted materially, in the case of the bladder, by the contraction of that viscus. As they become free, the surface of the mucosa is lacerated, and blood escapes freely from the torn capillaries and is discharged with the ova and urine. Although empty shells have been found in the left heart, and many ova in the lungs and liver of some cases, by Dr. Mackie, of Alexandria, still the *Bilharzia infarcta* of Sonsino do not appear to be of frequent occurrence except in the neighborhood of the living parasite; the position of the parents prevents the ova from making their way into the larger veins, and acts as a block to direct them toward the anastomosing capillaries, which, from their size, they cannot pass along.

When bilharzia are lodged in the veins of the urinary apparatus, they produce symptoms varying according to their number and position. In Natal, especially, many boys harbor the parasite without

much inconvenience; their general health is usually good; they have occasional attacks of lassitude, with pain in the loins or perinæum, generally after exertion, and they have intermittent hæmaturia, of which, however, they take but little notice, as it mostly disappears before puberty. The ova may, as Dr., Harley has pointed out, be still present in the urine when all other signs of existence of the parasite have disappeared. In more serious cases the symptoms are, in addition to those already named, the presence of muco-pus along with the ova and blood in the urine, frequent micturition, vesical tenesmus, and all the signs of chronic cystitis. The blood is usually passed almost pure at the end of micturition, and nearly always contains many ova. Post mortem or after a cystotomy, the mucous membrane is found to be swollen and ecchymosed in patches, usually on the posterior wall of the bladder, or showing here and there elevated thickenings, covered with a gritty material, composed partly of urates or uric acid, and partly of ova. In the interior of the thickenings are many yellowish-white specks, made up entirely of ova, lying in dilated vascular spaces. In other cases, where death has resulted from exhaustion or the supervention of typhoid symptoms, the bladder is small and contracted, its muscular wall greatly thickened, and the mucosa and submucosa involved in large, irregular, elevated lumps, with shreddy surfaces, lying mainly at the base and around the urethral orifice and constituting a veritable tumor of the bladder. It would appear (Bilharz and Meckel) that sixty-three per cent of the Egyptian fellaheen are infested with bilharzia.

A case which I saw in the Liverpool Royal Infirmary under the care of Dr. Davidson, and which seemed at first sight to be one of intermittent hæmoglobinuria, disclosed, on further investigation, the occasional presence in the blood-stained urine of ova closely resembling, if not identical with, those of bilharzia. The patient a man aged about forty, was a native of the Scottish highlands, and had never been abroad.

When the vessels of the ureter or renal pelvis are the habitat of the parasite, the results are usually more rapidly fatal, from the production of hydronephrosis, of pyelonephritis, or of acute suppuration of the kidneys. Obstruction of the vesical orifice of one or both ureters occasionally takes place from their involvement in the bladder tumors, and hydronephrosis or pyelonephritis may result. Males are much more liable to the disease than females. Provided the patient can be kept alive and free from reinfection, the disease must evidently have a self-limited duration, dependent on the natural period of life of the parasite. This is not yet very definitely ascertained, but appears to vary from one or two to ten years. It is to be noted

that the eggs of bilharzia often form the nuclei of uric acid calculi, which may not give rise to symptoms of their presence until some years after all indications of the parasitic disease have disappeared."

As bearing upon the clinical features and surgical treatment of this disease, I will quote the following remarks by Dr. Mackie relative to a specimen he forwarded me, which was shown at the Pathological Society of London by Mr. Butlin." It is now preserved in the museum of St. Bartholomew's Hospital. Dr. Mackie thus describes it:

"Specimen of diseased bladder, kidneys, rectum, and dilated and thickened ureters, from a fatal case of severe hæmaturia from bilharzia hæmatobia. The old man came under my care suffering from dreadful continued pains, and passing almost pure blood mixed with enormous quantities of *débris* containing ova of bilharzia. To ease the pain and examine his bladder, to see if the surface could be scraped or any tumor removed, I performed perineal urethrotomy. The bladder was found to be studded full of papillomatous-feeling tumors, bleeding freely. It was no use trying to remove any, as they were in dozens. So nothing further was done. The pain was eased, the hæmaturia diminished, but he died of uræmia a week afterward. Post-mortem examination showed that the walls of the bladder were full of small tumors filled with ova." To another specimen of the same kind of disease, Dr. Mackie refers in the following words: "This specimen is from a man who came to hospital for hæmaturia, passing blood and *débris*, with pus and mucus, suffering agony. I performed perineal urethrotomy, and drained the bladder, which, as usual, stopped the hemorrhage; but he died about a fortnight after of rupture of the bladder from destruction of the walls by ulceration caused by bilharzia." Dr. Mackie goes on to remark: "For some years I have been directing my attention to this disease in connection with urinary fistula, which is nearly as common as hæmaturia, and which I have proved to my satisfaction is caused by the same parasite, as in *every case* I find the ova in hundreds in the hard tissue around the fistulous tracks in the perinæum. In every case there is hæmaturia with ova in the bladder with a history of sudden phlegmon and perineal abscess, with no history of injury, or stricture, or gonorrhœa, or anything urethral to account for it. For a long time these cases of perineal urinary fistulæ puzzled me; men came in with their perinæums a large fibrous mass, riddled with sinuses and fistulæ, through which the urine passed on micturition; but no stricture, their urethra admitting easily the largest catheter, or, as often remarked to strangers, I believe their urethra would take in my little finger, and no history of previous stricture."

Various suggestions have been made relative to treatment, their object being to effect the destruction of the parasite in the blood. Har-

ley recommends the administration of the oil of turpentine and of male fern, with a little chloroform, in order to expel the ova from the urinary passages, and a solution of bicarbonate of potassium to relieve renal irritation. Dr. Fonguet [7] also advocates the use of male fern, observing that "the blood disappears from the urine after a few days' treatment. I employ the capsules of the ethereal extract of male fern, taking care to administer the medicine one hour before meals." For a similar purpose I believe the iodide of potassium, in twenty-grain doses, has been given.

Though I have no personal experience in the treatment of this affection, I should feel disposed to try, where the bladder was involved, a solution of corrosive sublimate as a wash (1–10,000); its use as a bactericide holds out some hope that it might be serviceable in the destruction of this parasite. Where perineal section is employed, as illustrated in the cases referred to, for the purpose of clearing the bladder of the excrescences formed within its interior by these parasites and their ova, irrigation with a suitable solution of corrosive sublimate seems worthy of trial.

This disease, though chiefly affecting the urinary apparatus, is not limited to it, but frequently involves the intestinal canal, producing symptoms simulating dysentery and disease of the lower bowel. Among the specimens which have been forwarded to me for examination is a polypoid parasitic excrescence in reference to which Dr. Mackie states: "This is a tumor removed by the écraseur from about four inches up the rectum of a man who came to me complaining of dysentery and prolapse of the bowel; he is now about, the dysentery and prolapse having disappeared since the operation. The man had also ova in his urine, but passed only a drop of blood at the end of micturition."

When we consider the serious injury which is done to native populations by this disease, in addition to the risk of contracting and spreading it that is incurred by troops and others visiting these districts, the importance of a more thorough knowledge of it, in relation to its prevention and treatment, must be admitted.

From an examination of numerous specimens it is found that carcinoma often occurs with bilharzia as a complication. Prolonged investigations in places where such cases are common, relative to the frequency with which bilharzia, cancer, and calculus coexist, and the order of their appearance, would be of value in reference to certain points in the natural history and pathology of these three affections. Whether the parasite merely plays the part of an irritant in a person in some way predisposed to generate cancer, or whether the relationship between the parasite and the proliferous tissue growths which we are accustomed to speak of as cancer is even more connected and

intimate, are points among others which naturally become prominent in connection with the pathology of this disease.

SINUSES CONNECTED WITH THE BLADDER.

Under this heading will be considered a variety of cases where sinuses have formed in connection with the bladder, but not necessarily in consequence of urethral stricture.

Looking over these cases of sinus or fistula, they will permit of being grouped in the following way:

(1) Those between the bladder and the intestines. (2) In the supra-pubic region leading to the bladder; (*a*) Arising from abscesses, (*b*) Arising from supra-pubic punctures or incisions. (3) Connected with the bladder, but opening externally in other directions then in the preceding. (4) Between the bladder and vagina (vesico-vaginal fistulæ). (5) Leading from the bladder into the rectum through the prostate or trigone; (*a*) Consequent on prostatic abscess, (*b*) Following puncture of the bladder from the rectum, or other similar procedure.

Class 1.—Fistulous communications between the bladder and intestines of a non-malignant character may be caused in three ways:

(*a*) By the passage of foreign bodies from the intestines into the bladder; these have been referred to in a previous section.

(*b*) By various kinds of non-malignant ulcerations, such as tubercular or dysenteric, proceeding from the intestine into the bladder, and, more rarely, from the bladder toward the intestines.

(*c*) By abscesses in relation with the abdominal viscera.

Non-malignant sinuses between the bowels and bladder vary much in degree, and these differences will, to a certain extent, serve as indications for treatment. The symptoms are usually these: more or less fæces and flatus find their way into the bladder, and if the sinus is sufficiently low down, as in the sigmoid flexure or rectum, urine may be passed in considerable quantities, either pure or mixed with fæces, by the anus. As a rule, these symptoms are the more marked when there is diarrhœa or flatulent dyspepsia; in fact some persons only suffer when the bowels are much disturbed. One patient describes his consciousness of the passage of air from the bladder when micturition closes with a slight fizzing sound, such as a soda-water bottle gives off. In another instance, the entrance of air into the bladder sometimes occasions an acute attack of vesical colic; and cases are recorded where intestinal worms have thus entered the bladder. In the following extract, Dr. W. D. Kingdon, of Exeter, sums up the particulars of a case which was reported and illustrated:[74]

Case.—The calculus on being carefully divided displayed in its centre a large pin, which satisfactorily accounts for the singular appearances detailed. The poor boy must have swallowed the pin, which, after traversing the small intestines, formed a lodgment in the appendix vermiformis; here the irritation caused by it must have given rise to inflammation and adhesion of the process to the exterior of the bladder, and subsequently by ulceration to the passage of the pin into the urinary bladder, where it formed the nucleus of a calculus discovered after death, though not detected during life. The fistulous communication with the bladder will likewise account for the voiding of the urine from the anus, the natural orifice being closed by the calculus; and also for the passing of the worms through the urethra on the several occasions mentioned.

The following illustrations are selected from a communication I made upon the subject:[b]

Case I.—A man, aged 58. Ten years before I saw him he was laid up for some weeks with acute pain in the lumbar region, which resulted in the discharge of pus into the bladder and its escape with the urine. On the sudden appearance of purulent urine the pain in the back ceased and he rapidly convalesced. On going about again, after this attack, he noticed the sputtering of air at the close of micturition, and this has recurred at times ever since, but has caused him no further inconvenience. The symptom about which I was consulted was the occasional discharge of a colorless fluid from the rectum independently of defecation. I did not see any of the fluid, but it was sufficient when it occurred to moisten the linen, and thus to make the patient uncomfortable. On examination of the rectum with the finger and speculum, I could not detect anything abnormal except a little irregular enlargement of the prostate, but not such as is usually met with in ordinary hypertrophy of this part. The urine was normal in composition, but there was a slight deposit which microscopic examination showed to contain elements of muscular tissue and vegetable fibre.

Case II.—I saw a man in 1887, aged 50, who two years previously suffered from some obscure abdominal symptoms in the region of the bladder, attended with acute pain, since which he had noticed feculent matter in the urine and the discharge of air at the close of micturition. Examination of the rectum disclosed nothing worthy of note further than that I was able by pressing on the prostate and posterior wall of the bladder to make urine mixed with feculent matter exude from the orifice of the penis. In all other respects this patient seemed to enjoy excellent health, and there was no evidence pointing to malignancy. I have seen him on two or three occasions since in consequence of his suffering from an acute paroxysm of pain over the region of the bladder. Each time I found the pain was due to the blocking of the prostatic urethra with a hardened nodule of fæces and the rapid distention of the bladder with air. Immediate relief was given by passing a catheter, which afforded vent to some feculent urine and a large amount of pent-up gas. This patient's symptoms were always intensified when diarrhœa was present. Though much

annoyed at times by these local symptoms, he continues, I understand, to enjoy good health and to lead an active life.

CASE III.—A man, aged about 60. His last illness commenced a short time before I saw him, with intense pain down the course of the right sciatic nerve, which lasted for rather more than a week; then retention of urine supervened from enlarged prostate, in addition to some urethral stricture which necessitated daily catheterism. In the course of a few days the pain in the back and leg entirely ceased, coincident with the appearance of pus in considerable quantity in the urine. The urine as soon as it became purulent was rendered most offensive, in spite of the bladder being washed out with disinfectants. He appears to have experienced some difficulty in urinating for several years, a circumstance which was probably due to the stricture in the urethra. He had not lost flesh and there was no evidence of malignant disease. The urine continued to be horribly offensive, as large quantities of gas and fæces were constantly mixed and discharged with it in spite of all the means that were used. He remained much in this way for about two months after I first saw him, and then lapsed into a comatose state, from which he never rallied. He was unwilling to submit to such operative measures as were proposed for his relief. The patient stated that when he was about 20 years of age he suffered from an abdominal abscess of some kind, when it was believed that a communication had taken place between the bladder and intestines, as pus, and what he thought was feculent matter had been at times discharged with the urine, but never sufficiently to cause him inconvenience. He had occasionally passed air at the close of micturition, which he likened to the expiring efforts of a siphon soda-water bottle. In all other respects he appears to have enjoyed good health. His urine was on several occasions examined for me by Sir William Roberts, and showed unmistakable evidence of intestinal contamination. The autopsy showed an opening near the top of the bladder, looking as though it had alway. existed, lined with mucous membrane, not patent but contracted, and resembling a miniature anus. No. 8 catheter passed easily through it into a cavity surrounding the descending colon, and formed by adhesions to the adjacent parts, which were with difficulty separated. This space contained no fecal matter, but was rough from inflammatory products, and communicated by several openings with the intestine. The colon took an unusual course; instead of passing down into the left loin, it curved across the lower part of the abdomen in front of the small intestines, and disappeared a little to the right side and under the bladder to its termination in the anus.

In reviewing cases of this kind, more particularly in reference to the question of treatment, we can divide them into two classes: (1) those where the inconvenience resulting is so slight as would hardly warrant the adoption of any important surgical interference; and (2) those where the inconvenience is an increasing one, either by a gradual process or by the intercurrence of acute symptoms, or where the condition of the bladder by decomposition of the urine be-

comes such as seriously to jeopardize the health of other parts of the urinary apparatus, especially the kidneys. I think it will be found that the cases quoted illustrate in some degree these deductions.

In reference to the first variety, there can be no doubt that persons live for many years and enjoy good health who are liable to the escape of gas and fæces in this way. I have had the opportunity of examining some of those cases which have been described under the term pneumaturia, implying that the urine or other secretion connected with the urinary apparatus had undergone some form of change by which gas was evolved, and either expelled or temporarily retained. I have no hesitation in stating that they were all instances of vesico-intestinal fistula. It has been urged that air is met with in the urine in certain cases of glycosuria, and Dr. Guiard proposed the term "diabetic pneumaturia."[76] I am not aware, however, that this observation has been confirmed. Gas in the urine may sometimes be caused in this way: An alkaline urine such as that secreted after breakfast is allowed to accumulate for five or six hours; then a discharge from the kidneys of a highly acid urine takes place, the resultant chemical action causing the production of carbonic acid in excess of what can be absorbed. Cases where the communication between the bowels and the bladder is evidently small and is not increasing, may be kept in good health by careful attention to digestible diet, and by restraining a tendency to diarrhœa, which invariably aggravates any special symptoms they may present.

Passing to the second class of cases, where the communication becomes gradually or suddenly enlarged, or where the urine is rendered so foul as to jeopardize the kidneys as well as other portions of the urinary tract, it is clear that some mechanical expedient in the shape of an operation must be considered. To effect any permanent good under such circumstances, it is obvious that the flow of fæces into the bladder should be prevented by causing them to escape by an artificial opening above the point where they are poured into the bladder, and thus to give the false passage a chance of contracting and closing. This is a proposition which, on paper, is an easy one to make, but in practice may be a difficult one to decide upon. It must not be overlooked that in many cases of vesico-intestinal fistula which appear to have taken their origin in an inflammatory condition, the viscus involved with the bladder was some portion of the small intestine. Taking, however, everything into consideration and the probability of our being able to distinguish when the latter is implicated, on the necessity arising, it is the safest practice to make the opening as high up in the large bowel as possible, and this will lead to the selection of some portion of the right ascending colon. In the

third of the above related cases I was much disposed, considering the condition of the patient, the state of his bladder, and the uncertainty as to where the false opening was, to give that immediate and safe relief which a supra-pubic opening could have afforded, and be guided as to the future by what this would have enabled the eye as well as the finger to discover.

I assisted Mr. Hakes, in 1869, to operate on a case of vesico-intestinal fistula by colotomy where the patient lived for five years and returned to his employment, subsequently dying of renal disease. I refer to it particularly, as opportunities of making an examination of the parts at a considerable interval of time after the operation are not very frequent."[17]

CASE.—The patient, a man, aged 20, with no history of syphilis, was admitted into the Liverpool Royal Infirmary in 1869 suffering from the passage of fæces and flatus into his bladder. He was in a very miserable condition. He appears to have had some history of difficulty in passing his motions for three years previously. The rectum was unhealthy from ulceration, and a sound could be passed from the bladder into the bowel. Left lumbar colotomy was performed, and the patient made a good recovery. He resumed his employment as a bus conductor, and for over three years enjoyed perfect health and suffered but little inconvenience from his artificial anus. Then he appears to have fallen ill, and was readmitted into the Infirmary in 1874, where he shortly afterward died from renal disease. He never had any return of his vesico-intestinal fistula. The post-mortem examination was made by the late Dr. Michael Harris, who attached a drawing of the part to the published records of the case. It is sufficient here to state that the colon from the artificial anus to the bladder was obliterated and converted into a coil of fat: the fistulous opening from the rectum into the bladder was also soundly closed, nothing but some old cicatricial tissue remaining. The patient died from uræmia as a result of degeneration of the kidneys. No further light was thrown on the nature of the old ulceration by which the bladder and bowel had been made to communicate other than to demonstrate its non-malignancy.

It should be remembered that when the communication with the bowel is in the small intestine, as is usually the case, neither the air emitted with the urine nor the products of digestion entering the bladder are necessarily either tainted with the odor of fæces or have their appearance, as the case may be. With the cystoscope, in a clear medium it is quite possible to see bubbles of air emerging from the orifice of the false route and entering the bladder.

Whenever there are signs of fæces entering the bladder, care should be taken that washing out the viscus is employed, otherwise a concretion may be formed, as in a case recorded by the late Mr. Charles Hawkins."[18]

Ulcerations proceeding from the bladder toward the intestines are much less common than the preceding, and are liable to be followed by fatal results before the communication has had time to assume the characteristics of a chronic sinus. Belonging to this class is the case recorded by the late Mr. T. H. Bartleet, of Birmingham, where a perforating ulcer of the bladder made its way into the ileum and caused death, as it were accidentally, by setting up peritonitis.[79] The ulcer, while confined to the bladder, appears to have gone through all its stages without presenting any symptoms, and while the patient continued to follow his accustomed occupation. A sudden lifting movement, which occasioned acute pain, probably broke down a recent adhesion between the bladder and bowel, and led to extravasation of urine, which caused death.

Class 2.—Sinuses in the supra-pubic region leading into the bladder. These are of two kinds—(*a*) arising from abscess; (*b*) from wounds, surgical or otherwise. Abscesses in the supra-pubic region may be confined in the space known as the *porta vesicæ*, and eventually open both into the bladder and externally, though they are apt to burrow considerably, and thus prove difficult to heal. Sometimes they are connected with caries of the pubic arch, or with disease of the symphysis. In the following case the course and treatment of these abscesses are illustrated:

Case.—In 1885 I saw, with Dr. H. W. Knowles, a woman aged about 20, under the following circumstances: Fifteen months previously she had some swelling and pain about the left groin. Three months before I saw her an abscess formed above the pubes, which was opened externally, and found to communicate with the bladder. A sinus formed, which resisted all efforts to close it, including continual catheterism. When we saw her, the abdominal parietes were undermined, and urine welled up through the opening when the catheter was removed. It was advised that the sinuses should be opened up and the catheter again worn. This was followed with improvement, but when the catheter was removed urine still escaped by the wound. Then we found, on further examination, that the urine had burrowed under the attachment of the left rectus muscle. This we divided close to the pubes, when the wound soundly healed.

Wounds and punctures made into the male bladder above the pubes, either accidentally or for surgical purposes, usually heal when there is nothing in the condition of the prostate or urethra to interfere with the escape of urine by the natural passage, though they are sometimes tedious. Where there is a urethral stricture this must first be treated. A discharge of urine from the umbilicus, due to a congenitally unobliterated urachus, is occasionally met with. If there is any obstruction in front, such as a phimosis, or a contraction

in the urethra, this should be removed, and then an endeavor may be made to close the sinus by cauterization, or a plastic operation may be attempted, as already mentioned.

Class 3.—Sinuses connected with the bladder opening externally in other directions than those specified. These sometimes take long and tortuous courses. In a case where Mr. Bickersteth had successfully removed, at the Liverpool Royal Infirmary, a large oxalate stone by the supra-pubic operation over twenty years ago, the only prominent symptom was a sinus discharging urine which opened near the great trochanter. Some remarkable instances are recorded, chiefly in the practice of military surgeons, where fistulous communications with the bladder have been caused by gun-shot injuries, and maintained by the lodgment of portions of the missiles and clothing or of bone within the viscus. Unless there has been an extensive breach of surface these openings have usually healed on the removal of the cause. Cases of this kind point to the necessity for a careful examination of the bladder in all instances where a discharge of urine by the wound indicates that a fistulous communication exists. Abscesses connected with the bladder within the pelvis sometimes give rise to long sinuous tracts through which the urine escapes. In a case I have recently seen, the whole of the urine was discharged through an opening halfway down the front of the thigh. I gave some relief by establishing a supra-pubic fistula, but as the case was a malignant one, the benefit the patient derived was only temporary.

Class 4.—Sinuses between the bladder and the vagina. These are more generally known under the name of vesico-vaginal fistulæ, and are for the most part remedied by plastic operations effected from the vagina. Trendelenburg [80] records two instances where he succeeded in closing such fistulæ by opening the bladder above the pubes by a transverse incision. This enabled him to pare the edges of the fistula, and to close it with sutures, the knots of which were made to fall within the vagina. The late Mr. McGill [81] also recorded two similar instances. It seems likely, however, that the supra-pubic operation will be limited to exceptional instances, where either the fistula is large or its position is such as to render it desirable that the interior of the bladder should be seen, as, for instance, for the purpose of avoiding the orifice of a ureter. The vaginal operation is on all other grounds to be preferred, as it is safe and not usually difficult. Mention may here be made, in connection with some very extensive forms of vesico-vaginal fistula where a plastic operation is for some reason or other out of the question, of Dr. N. Bozeman's [82] vesical drainage supports. The apparatus consists of a flattened pear-shaped metal pessary for insertion into the vagina, terminating in a contracted por-

tion to which a drainage-tube is attached. The latter conducts the urine into a bag secured to the patient's thigh. The upper surface of the support is concave, and perforated with holes.

Class 5.—Sinuses leading from the bladder into the rectum through the prostate or trigone;

(*a*) Consequent on prostatic abscess.

(*b*) Following puncture of the bladder from the rectum, or other similar procedure, or from injuries inflicted on the parts.

Sinuses occupying this position can generally be demonstrated by the speculum or rectal endoscope. I have found the latter instrument of much service in this class of cases, as I have on several occasions been enabled to see an opening which could not otherwise be inspected. In making an examination by the endoscope, the patient, having previously had his rectum emptied both by an aperient and an enema, should be placed in the lithotomy position, when it will be found possible to explore the bowel for at least six inches. After the aperient has acted it is well to steady the bowels by some astringent such as chalk and opium, as Mr. Howse suggests. The causes of these sinuses may be divided into two classes.

(*a*) *Prostatic Abscesses.*—Matter formed in this position, either arising from tubercular deposit in the follicles or from follicular prostatitis, will sometimes burst into the rectum and establish a fistulous communication. Sinuses thus formed are difficult to heal by reason of their position; if, however, the openings are small, and the patient is not suffering from urethral stricture, but little inconvenience is occasioned. In one instance, where the rectum was much excoriated by the constant dribbling of urine, as the opening could be seen with a speculum, the fistula was touched with a cautery wire, and the patient was made to lie on his abdomen for a fortnight. This expedient proved successful.

(*b*) *Fistulæ following Punctures and Wounds.*—Cock's operation of puncturing the bladder above the prostate, and proceedings of a like nature through this part, have been followed by fistulous communications. In these cases it must, however, be remembered there is usually the complication of a urethral stricture. The first indication in treatment is to remove, where practicable, the obstruction. Instances, however, will be found where these fistulæ have proved permanent by reason of the nature of the obstruction, the rectum being used as a common receptacle for urine and fæces, and it is remarkable how little inconvenience is suffered by some of these persons. As a rule, when the fistulæ occupy this position, and are small, the passage of fecal matter into the bladder is seldom complained of; but should the opening be of such a size as to allow the contents of the

rectum to pass into the bladder and distress the patient, then the propriety of colotomy would have to be considered. Some years ago I met with a patient who had been operated upon in this way. He told me that he passed all his fæces quite comfortably through a colotomy, and reserved his rectum for his urine, as his urethra was entirely obliterated by an old stricture. I only saw him on one occasion, and had no opportunity of further verifying his statement, but he appeared to be in excellent health.

Fistulous communications of this kind are sometimes the result of injuries accidentally received. The following instance illustrated a remarkable form of injury, and a result which was certainly better than could have been anticipated:

CASE.—In 1871, I saw a boy, aged 14, who, in endeavoring to pass between a railway wagon and locomotive, became empaled on the coupling, and was squeezed with much force. When I examined him there was a lacerated wound of the rectum, caused by the entrance of the hook, almost encircling the bowel. The membranous urethra and back of the bladder were bared, but not torn across. Ten days afterwards it was found that urine and fæces flowed from the bowel, which was in a sloughing condition. Eventually he recovered, but the whole of his urine was passed by the rectum.

I saw this patient about fifteen years afterward, and was surprised to find, considering the extent of his injuries, how comparatively comfortable he remained. The rectum answered fairly well the double function of bladder and bowel. The membranous urethra, prostate, and a portion of the posterior wall of the bladder were involved in scar tissue. The case was quite beyond the reach of any plastic operation.

In one instance of vesico-rectal fistula I had to abandon an attempt to close the false route by a plastic operation conducted through a supra-pubic opening, by reason of the vesical aperture not corresponding directly with the intestinal. Had I closed the bladder opening by sutures, as I think I could have done, there still would have remained a considerable pouch connected with the intestines, in which fecal matter would have lodged. The patient was a young man who had suffered from this fistula for some years. The attempt thus made to close the sinus was followed by acute cystitis, in the course of which the entire mucous membrane was exfoliated and removed like a bag with a hole in it through the supra-pubic opening, somewhat resembling a case previously described. The wound healed, but the connection between the bladder and bowel still exists, though it has since contracted considerably. As a recurrence of calculus may take place, there appears to be no alternative but that of establishing

an artificial anus by opening the bowel at a point above where it communicates with the bladder. Atrophy of the gut below the line where the artificial anus was made would be likely to lead to a closure of the false route, as happened in an instance already referred to.

STONE IN THE BLADDER.

A stone in the bladder usually indicates its presence in a variety of ways, any one of which may be sufficiently significant to lead the surgeon to proceed to determine its position by demonstration with the hand and the ear. A calculus is, as a rule, a source of more or less constant irritation; it frequently provokes hemorrhage, especially after exercise, and it is generally associated with some reflex pain, of which that at the end of the penis is the most constant. Though in the majority of cases these symptoms are more or less combined in varying degrees, we occasionally meet with instances where there is perhaps only one prominent indication. In male children it sometimes happens that constant preputial irritation, or prolapse of the rectum, is the only symptom suggestive of the presence of a stone in the bladder. A patient when he first came under my observation complained only of slight hæmaturia after taking a long walk, which he usually did once a week. The constancy of this symptom in connection with his exercise was suggestive; he was sounded, and a lithic acid calculus detected, which was removed by crushing, when the hemorrhage disappeared. It is curious to notice that very large stones not unfrequently give but slight symptoms of their presence. In some cases, where stones weighing many ounces have been removed by the supra-pubic operation, the patients appear to have suffered but little inconvenience from them, probably because, by reason of their size, they became almost stationary.

It being important to detect a stone in the bladder in its earliest stage, we should not sanction the treatment of a case of vesical irritability, otherwise unexplainable, without sounding the patient. It is impossible for any one to conclude from symptoms alone what a bladder may contain until a sound has been introduced, when positive evidence is afforded.

Sounding may be practised under the following circumstances, when the cause is not otherwise explicable, or symptoms pointing to the bladder continue in spite of treatment: (1) In children suffering from vesical irritability, incontinence of urine, sudden interruption to micturition, retention of urine, blood in the urine, penile irritation inducing the pulling of the foreskin, and prolapse of the bowel. (2) In the vesical irritability of adults after attacks of renal colic, where

there are reasons for believing a calculus may be retained in the bladder; in cases of hæmaturia of a doubtful nature, or of chronic mucopurulent or ammoniacal urine, or where the urine contains, on standing, an excess of cloudy mucus. (3) In pain after micturition, referred to the end of the penis. (4) In the enlarged prostate of elderly persons, with persisting symptoms of vesical irritability. (5) Where calculi, or portions of them, have been spontaneously passed, and symptoms of irritation continue. (6) In cases of acute vesical spasm terminating the act of micturition, or where, though the bladder contains but little urine, there is frequently a sudden and uncontrollable desire to micturate. Though the indications of stone may be numerous, it will be seen that they all have reference to either a persisting source of irritation within the bladder, or a mechanical interference with the act of micturition. In by-gone days the modes of ascertaining whether a patient had a stone in his bladder were very primitive. An old practitioner told me that an eminent surgeon of the last century often grounded his opinion upon this point by the manner in which the person conducted himself on being desired to jump on the ground, from, say, the height of a chair. Now, the process is conducted on very different lines.

As a rule, I prefer that patients, when sounded, should have an anæsthetic, not because the process is necessarily a painful one, but for the purpose of making a complete examination. Formerly, on its detection, when there was only one method of operating for stone, its removal by lithotomy naturally followed. In the present day, where the choice of procedure has been extended, more precise information is required before we can determine whether the stone in a given case will be better removed by a crushing or a cutting operation. In advising an anæsthetic it is not merely on the grounds that the process of searching may be a disagreeable one, but also and mainly, in cases of difficulty, that a complete relaxation of the parts may be secured. Large, rigid prostates and contracted bladders are sources of error which can only be completely removed by an anæsthetic. But if on sounding the patient it should be proved that he has not a stone in his bladder, we are often none the less dependent on the information the use of the sound affords for our future guidance. In some cases we have to eliminate the possibility of disease in the bladder or the parts below, before the physician can undertake the sole responsibility of their care. In others, though there is no stone, there may be tumor, tubercle, or ulceration, which the skilful use of the sound can aid in determining. Hence, as a rule, sounding must be conducted with that deliberation which can only be when an anæsthetic is employed. When it is not administered much of the sensitiveness

of the deep urethra may be removed by a preliminary injection of a ten-per-cent solution of cocaine before passing the sound.

In the majority of instances, I believe it is better practice to sound and remove the stone at the same time. In persons with fairly normal bladders the gentle movement of the stone with the sound is a matter of little consequence; but with stones more or less fixed in one position—as is so often the case where the prostate is large and the bladder pouched—the conditions and risks are very different; urine gets into the depression the stone has so well filled, some cystitis is set up, there is an unnecessary delay which is trying to the nerves and the sensations of the patient, the sleep is disturbed; and the surgeon finds himself almost obliged to operate (most probably by crushing) with a bladder, as well, perhaps, as the dilated parts above, infected with some of the worst varieties of bacteria. In a personal experience of lithotrity, now amounting to considerably over 300 cases, I have noted that not a few of the most rapid and complete recoveries followed when sounding and removal were concurrent. One anæsthetic covers the whole procedure, and the patient is spared needless suspense.

The risk connected with the sounding of an adult who has not been in the habit of using a urethral instrument is probably greater than that which attends the removal of a moderate-sized stone by lithotrity as now practised. In the latter case all antiseptic precautions are taken, and the use of an anæsthetic renders the parts involved less liable to any subsequent inflammation. The tissues are thus rendered lax and the process of crushing the stone is both painless and simple. Children and women, though the risk of sounding is not the same, should invariably be spared through anæsthesia, being either alarmed or pained by having an instrument passed into the bladder.

In the selection of instruments for sounding we all have our preferences as regards curves and construction. I use a solid steel sound,

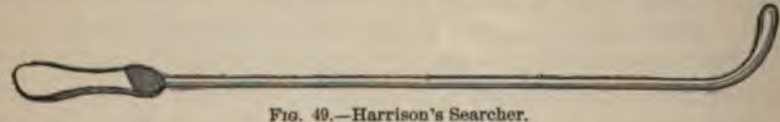


Fig. 49.—Harrison's Searcher.

nickel-plated, not exceeding a No. 8 English bougie, of the shape here shown (Fig. 49). Some sounds are so thick in the shank that they actually *fit* the urethra, and consequently the bulb of the instrument cannot be made to pass as easily as it should do over all parts of the mucous membrane of the bladder, including the dip behind the prostate. As a rule, sounds are too short. Where the prostate is large they should not be less than fourteen inches in length. I have

no partiality for what are described as hollow sounds. Unless there is some necessity for combining a catheter with an explorer I would sooner not incur the risk of admitting air into an organ where it may do harm by aiding to cause decomposition. Though it is usually desirable to have some fluid in the bladder when sounding, this can generally be secured by other means. A careful study of the alterations effected in the passage by which the bladder is entered in prostatic enlargement leads me to conclude that some variations in the shape of sounds is desirable, though these structural obstacles usually disappear under an anæsthetic. A long copper probe, sufficiently flexible for adaptation to any shape required, is an instrument I have used in instances such as these. Bigelow used to search for stone with a block-tin sound, bent up extemporaneously to suit the case.

I generally pass a "whip," or soft bougie, before introducing the metal sound. By this device the closed urethra is opened and greased and the more rigid instrument will then slip in easier; this is equally important, whether or not an anæsthetic is used, as it is desirable that no damage should be inflicted on the parts traversed. Where the prostate is large this object is not so easily attained, and therefore these precautions are not superfluous.

Before sounding, an examination of the urine is desirable. Where there is any degree of kidney complication, rest in bed, warmth, diluent drinks, and doses of aconite or quinine have frequently prevented or moderated uncomfortable symptoms following sounding. To sound persons, as a rule, in the consulting room, when seeing them for the first time, and perhaps fatigued by a journey, is incurring a risk which is often unnecessary, and which we may have cause to regret. In sounding, let it be remembered that the instrument is merely an imperfect substitute for the finger, and to obtain the information required it will be necessary to conduct the operation with the same method as we should adopt in the digital examination of any cavity or space in the body which can be so reached. To pass a sound into the bladder, and aimlessly move it about on the chance that it may touch a stone or reveal a rugged or ulcerous surface, is not likely to be of much service.

Should there be a stone, its presence will probably be recognized both by the touch and the ear. A stethoscope applied over the pubes renders the sound more audible, and may be resorted to if there is doubt. The size of the stone can generally be ascertained by the lithotrite, while its probable nature is indicated partly by the character of the note that is obtained; the dull "thud" of the phosphates is as characteristic as the sharper "click" of the oxalates or urates; and, further, the examination of the urine often adds evidence which

is conclusive. Where there is a suspicion of a stone, which cannot be detected by sounding as described, an examination may be made on a subsequent occasion, with the patient in a different position. The sound may be passed with the patient standing and leaning forward, with his hands on the back of a chair, and his legs apart, or even when lying on his belly.

The difficulties which arise in making a diagnosis of stone in the bladder are for the most part traceable to the existence, as a complication, of one of the following conditions: First, the presence of a stricture or an enlarged prostate; secondly, a diverticulum, or recess within the bladder, in which a calculus may be lodged; and thirdly, the coating of the stone with an imperfectly organized, leather-like substance, which conceals it from detection with the sound.

Mr. Buckston Browne[83] has drawn attention to a source of difficulty in detecting stones when lodged in what he describes as a post-prostatic or trigonal pouch. In such cases he suggests not merely searching with the end of the sound in the reversed position as it lies in the bladder, but with an instrument constructed, so far as the beak is concerned, like a flat-bladed lithotrite. The object of the latter is more readily to enter the slit-like opening of the pouch it is desired to explore. Under such circumstances I have found the distention of the rectum with a rubber bag of service in bringing pouched calculi within reach of the sound as well as of the lithotrite and evacuator catheter.[84]

Examination of the supra-pubic region with the hand ought also not to be omitted. I was reminded of the importance of this on looking through the specimens in the Museum of the New York Hospital. Appended to one (784), where there was a sac larger than a hen's egg opening into the bladder near the fundus, in which were several calculi, is the note: "These calculi could not be detected by the sound during life, but the pouch containing them could be felt through the abdominal parietes."

There are probably no urinary cases presenting greater difficulties, both in diagnosing and treating, than those of rugous bladders, where phosphatic concretions are deposited on elevated and circumscribed portions of the mucous membrane. By the sound, something closely resembling a stone may be felt, but the absence of a distinct "ring," as the instrument comes in contact with the suspicious spot, as well as its fixity in position—unalterable by the use of the instrument, by changes in the posture of the patient, and by distention of the bladder with water—render the diagnosis tolerably easy. I have frequently remarked, in examining the bladders of persons who have died with greatly enlarged prostates, or with saccules or bars across them, how

impossible it would have been, if the cases had been complicated with stone, to detect it with the ordinary sound, provided the stone occupied a position which could be indicated. These are the instances where symptoms are almost sure to arise simulating stone, and necessitating an exploration to determine this point.

In the last place, the stone may be so constituted as in itself to oppose a difficulty to its detection by the means usually employed.

CASE.—In 1863, a boy was admitted into the Liverpool Royal Infirmary, under the late Mr. Long, suffering from prolapsus ani, purulent urine, and painful and frequent micturition. He was sounded, but without any evidence of stone being afforded. Death occurred in a few days. On making a post-mortem examination, the kidneys were found disorganized. The bladder was small and contained a calculus, made up of a urate of ammonia nucleus the size of a damson stone, surrounded by a thick layer of soft material consisting of mucus, fibrin, and a little gritty, phosphatic matter. The outer covering could be cut or torn easily; and after it had been in spirit it presented, on section, a laminated appearance, like the fibrinous layers of an aneurism. On striking the mass with a metal instrument, no ring was produced; hence the impossibility of determining its existence with the sound during life.

Mr. Bickersteth* records a similar instance.

Where the stone cannot be readily reached with the sound, means may be taken to bring the two in contact. This may be done by a plan which Dr. Freyer suggests: "A most careful search was made by means of sounds of various kinds, but no calculus could be detected till the aspirator was employed, when a distinct click was felt during the exhaustion of the water from the bladder, and due to the calculus being carried with force against the eye of the canula by the outward stream. The sound of the fragments clicking against the eye of the canula during the evacuation of the fragments of a calculus, in the operation of litholapaxy, suggested this mode of diagnosis, and I am now in the habit of having recourse to it when the symptoms of stone are well marked, and the sound fails to detect the presence of one in the bladder."

It should be remembered, as with all surgical procedures, however slight, that the general condition of a patient may render even sounding inexpedient at the moment. I once attended in consultation for the purpose of sounding and clearing up a case of suspected stone, where we noticed at the time that the patient had a slight erythematous-looking blush about a trifling abrasion caused by the razor on

* Liverpool Medical and Surgical Reports, vol. i., 1867. This form of calculus (fibrinous) appears to have been first described by Dr. T. Hodgkin, Guy's Hospital Reports, vol. ii., 1837.

the patient was convalescent. At that date I understood this operation had been practised fourteen times—including a case each by Dr. J. C. Warren and the late Dr. Curtis, of Boston—with but one death. I was much indebted to Dr. Bigelow, not only for the explanation he gave of his method of operating, but also for permitting me to take part in the various manipulations. In the same year I reported to the British Medical Association, at Bath,[86] what I had seen, and exhibited, I believe for the first time in England, Dr. Bigelow's apparatus. Shortly afterward I performed the new operation, and have continued to do so. In the removal of some large stones the time taken up has been considerable. In a successful case reported by Professor Cheever,[87] of Boston, the operation lasted three hours under ether, the stone being composed of oxalate of lime. In a patient from whom I removed with safety a stone weighing upward of two ounces the operation lasted over two hours. Reference is made to such exceptional cases as these merely to show that there need hardly be any time limit, so long as the manipulations are carefully conducted. It will be convenient to discuss the question relating to the selection of an operation in a given case after the various details have been described, and I will therefore offer some remarks on the instruments employed and their use.

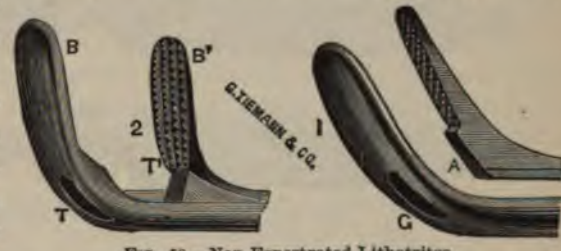


Fig. 50.—Non-Fenestrated Lithotrites.

Lithotrites are required of different sizes and strength, proportionate not only to individuals of almost all ages, but to stones of various dimensions and composition. These instruments are of two kinds, smooth-bladed (Fig. 50) and fenestrated (Fig. 51), the former being adapted to the lighter kinds of work, and the latter to the largest and hardest specimens of stone which come within the range of lithotrity. The modern instrument is constructed to permit of the male blade sliding within the female, so as to enable the surgeon to seize the stone or fragment, as the case may be. This is accomplished by means of a button on the handle, and without moving the position of his hands the operator can fix the stone within the grasp of the instrument, and at the same time bring into play the

Fig. 51.—Fenestrated Lithotrite.

mechanism necessary for the screw or breaking movement. There are other contrivances for accomplishing the latter object. In many of the French instruments the change from the slide to the screw is effected by a catch which can be elevated or depressed as required by the alternate movement of the thumbs. I think the former method is generally preferable. In bringing the screw action on the stone into play, a wheel is usually provided (Fig. 52), which is grasped between the index finger and the thumb.

FIG. 52.—Wheel Handle for Lithotrite.

The more powerful lithotrites of Bigelow are fitted with a ball-handle (Fig. 53), and rotation is thus effected, though I prefer the wheel movement. With the former, I have no doubt, greater power

FIG. 53.—Bigelow's Ball-Handled Lithotrite.

can be obtained, but at the sacrifice of some delicacy in manipulation. Knowing what the fenestrated instrument with the wheel is capable of accomplishing, I question, in the case of a stone requiring greater force than this, whether, with possibly some exceptions, it is prudent to select lithotrity under such circumstances unless provided with considerable practical experience. Lithotrites are made of the following sizes (English gauge):

FOR CHILDREN.		FOR ADULTS.	
5 in. stem,	5 in. bend of blades.	9 in. stem,	12 in. bend of blades.
6 do.	6 do.	10 do.	14 do.
7 do.	8 do.	12 do.	18 do.
8 do.	10 do.		

We cannot be too careful in the selection of these instruments, when we consider the strain that is put upon them and the damage that might be occasioned by their bending or breaking. The best material and workmanship should be required. Upon this point Dr. Keegan[38] remarks: "I would warn the inexperienced against the fatal economy of buying cheap, and therefore badly made and untrustworthy, lithotrites. There are plenty of such instruments in the

market, and they may prove, even in skilled hands, most dangerous weapons of destruction."

Care should also be taken by the operator in seeing that all the movements of the lithotrite are without hitch or friction, so that nothing may intervene between his sensation of touch and the stone. The smaller the calculus or fragment the greater is the necessity for this accuracy in adjustment. Further, it must be ascertained that the outer blade well protects the inner one, especially where the stone is seized and the two parts of the instrument are made to approximate. These are points among others which the surgeon should himself attend to and test in selecting his lithotrites. It is well for the operator to be provided both with fenestrated and smooth-bladed instruments, as the latter are very useful, especially in the case of soft stones or small fragments. All lithotrites are liable to become impacted with *débris;* generally speaking, by reversing the screw action and giving the instrument, whilst firmly held, one or two sharp taps with a concussor of some kind, the hitch is overcome. It is seldom that the impaction is of such a nature as to render the closure of the blades impossible. Mr. Cadge has informed me that such an occurrence once happened in his practice. In using a lithotrite for measuring a stone in a male child, with the view of ascertaining whether it could be crushed, on seizing the calculus and lightly closing the blades upon it, he found to his astonishment that the instrument, though one of the best of its kind, was absolutely locked. He could neither close nor open it, and no force he could safely apply being of any avail, he performed a supra-pubic cystotomy on the end of the lithotrite, and by protruding it was able with his finger to clear the instrument from the *débris* which had impacted it, the patient making a good recovery.

The stone having been broken into fragments by one or more introductions of the lithotrite, the *débris* is removed by means of a large-

Fig. 54.—Harrison's Evacuator with Large Eye.

eyed catheter and a syringe or aspirator filled with water. The catheters for this purpose are of two kinds, straight and curved. The largest I employ corresponds with No. 26 of the French gauge, and from this size they gradually diminish until we come to those appro-

priate for children. The eyes of my evacuators (Fig. 54) are rather larger than those in general use. It is very necessary that all these instruments should be provided with a stylet (Fig. 55) so that they

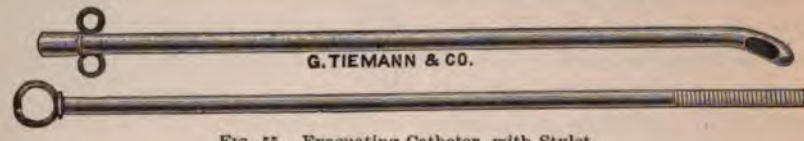


Fig. 55.—Evacuating Catheter, with Stylet.

may not become impacted with fragments. If an evacuating catheter is withdrawn with a sharp fragment retained in the eye, the urethra may be wounded and much damage done. If there is the slightest resistance on attempting to withdraw the instrument the stylet should be at once passed. Bigelow preferred a straight evacuator. They are almost as easily introduced as curved ones, but the latter are generally used.

For withdrawing the fragments from the bladder rubber aspirators

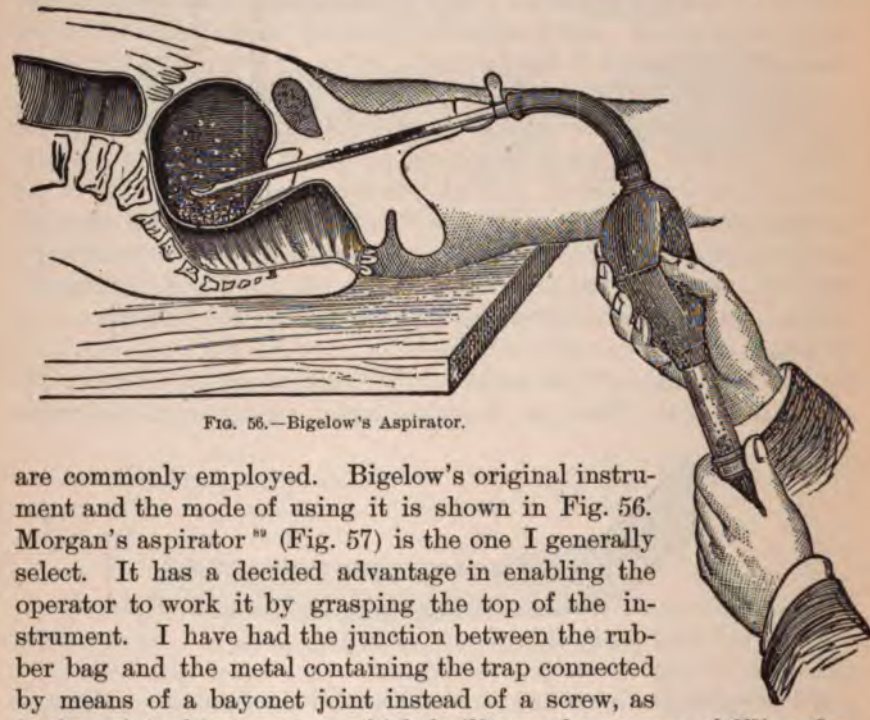


Fig. 56.—Bigelow's Aspirator.

are commonly employed. Bigelow's original instrument and the mode of using it is shown in Fig. 56. Morgan's aspirator [89] (Fig. 57) is the one I generally select. It has a decided advantage in enabling the operator to work it by grasping the top of the instrument. I have had the junction between the rubber bag and the metal containing the trap connected by means of a bayonet joint instead of a screw, as in the original instrument, which facilitates the process of filling the bottle with water; the addition of the tap has also proved a convenience.

I have two or three aspirators employed at an operation, one in work while the others are being refilled out of a bucket of water. All the evacuators I have tried are open to the objection that occasionally fragments will be washed back again in spite of the trap, thus necessitating a second withdrawal.

The possibility of washing back fragments by the method of aspiration, as just referred to, seems to have led Guyon and others to alter their method of procedure in crushing and evacuating stones. This consists in triturating the stone so finely by the lithotrite as to enable the powdered particles to run out through a large-eyed catheter by frequently filling the bladder with water by an ordinary syringe. This practice, I have found, has much to commend it. It is to be remembered that as all these aspirators consist largely of rubber, care is required that they be kept thoroughly clean and aseptic; in fact, the same precautions should be taken in regard to them as with catheters.

FIG. 57.—Morgan's Evacuator.

Having thus referred to some of the instruments employed in lithotrity, I will now proceed to speak of their use, which will best be done by taking an ideal case, where, for instance, an adult male otherwise healthy, with a normal bladder, is suffering, we will say, from a lithic acid calculus of moderate size. The stone having been discovered and lithotrity decided upon, there are a few preliminaries which may be noticed. In the first place, due regard should be paid to those points which we recognize as of importance in connection with all patients who are about to undergo an operation confining them for some days. Rest to the parts involved and regulation of the diet and the bowels are attentions which will not be disregarded as being conducive to well-doing.

When stone is complicated with a distorted bladder, as in some instances where the prostate is large, it is not a bad plan to turn the

patient on his belly, after he is anæsthetized, and to slightly concuss his body. Stones will often thus fall out of a pouch into the cavity of the bladder, and if a small sponge, secured by a tape, is passed into the rectum before the patient is replaced on his back, the seizing and evacuation of the calculus by the lithotrite and aspirator will be facilitated. I have several times found this expedient of service.

At the time of operation care should be taken that the patient is well protected against exposure, and I generally see that the legs and thighs are encased in loose flannel leggings, which can be readily slipped on, and are also a protection against wet. By this means the genitals are the only parts exposed. The patient should be placed on a suitable operating table, or its equivalent, care being taken that its height is proportionate to that of the operator. I seldom use chloroform, my preference being either for the combination of nitrous oxide gas with ether, or what is known as the A. C. E. mixture, the latter consisting of one part of alcohol, two of chloroform, and three of ether. I have never had cause to regret these selections. Mr. Lawson Tait[90] has observed that the administration of ether sometimes completely arrests the secretion of urine. He illustrates this by a case where for this reason he failed to detect and cure a uretero-uterine urinary fistula. When chloroform was substituted the opening was discovered and closed. Cocaine is not to be relied upon as being efficient so far as lithotrity is concerned, though it suffices for such temporary purposes as the passing of an instrument along the urethra. The patient being anæsthetized by a competent administrator, he should first be placed with the pelvis slightly raised on a pillow, a position which may be altered according to circumstances. Before using any other instrument, I usually commence by washing out the bladder with boracic lotion by means of the aspirator catheter and wash-bottle. This fulfils three objects: (1) it assures to the operator a clean and not a foul bladder in which to work, (2) it permits any small stones to be withdrawn without being broken, and (3) it allows of sufficient fluid being left behind to facilitate the movement of the lithotrite in searching and crushing, and thus affords a protection to the mucous membrane.

In commencing to crush and evacuate, the operator should endeavor, as far as possible, to render the proceeding a bloodless one, by causing damage neither in the introduction of instruments along the urethra, nor in his efforts to seize and crush the stone. It is often possible to conduct an operation of this kind, even of some duration, with but little discoloration of the water in the aspirator. This is difficult to accomplish when the prostate happens to be large and obstructive. Any extensive damage of this kind proves a serious ob-

stacle to the success of lithotrity, and when unavoidable, is a sufficient reason for the immediate substitution of some form of lithotomy. Much time may often be saved in performing lithotrity, not by any sacrifice of safety to speed, but by previously seeing that the nurses are well versed in clearing the lithotrites when not in use, filling the wash-bottles (without air), and in recognizing and handing the exact sized evacuating tube the operator is using. Where I have had to operate with excellent nurses by me, but unused, by reason of want of practice, to this kind of work, a quarter of an hour, or even more, has easily been lost, and anæsthesia unnecessarily prolonged. This is the only kind of economy of time that can be justified.

Stones of an elliptical or ovoid shape more commonly lie with their long diameter in a direction corresponding with the line of the urethra, and are generally first seized in this axis by the lithotrite. Hence calculi may appear larger than they really are. My attention was first directed to this point by my friend Dr. Freyer, whose opportunities of judging in reference to all matters connected with stone have been extensive in India. Naturally our object is to seize the stone in its shortest diameter, if we are going to crush it, as simplifying the operation and throwing less strain on the lithotrite. Consequently this may necessitate a change in the first position of the lithotrite relative to the stone, for which, in addition to other reasons, some fluid in the bladder is required. In lithotomy, on the other hand, this rather constant position of oblong stones relative to the outlet from the bladder is favorable to their more speedy withdrawal.

The bladder having been cleansed and the lithotrite introduced, the surgeon taking his place on the patient's right-hand side, the stone is carefully sought for. This may render it necessary to reverse the position of the instrument so as to enable the operator to feel for and pick up anything which may be lying behind the prostate in the most dependent portion of the bladder. The stone having been seized and the screw power adjusted, the lithotrite should be slightly and gently rotated with the left hand, so as to see that it is quite free from the coats or rugæ of the bladder. I consider this the most important movement in connection with the process of lithotrity. It may be almost imperceptible to the casual observer by reason of its delicacy, but it should on no account be omitted. Its full recognition makes all the difference between an almost bloodless operation and otherwise; and further, it is the means of preventing the introduction of much cicatricial tissue within the bladder wall. Probably there is no operation where more fineness in manipulation and patience are required than in lithotrity, as it is entirely dependent for its success upon that kind of touch which is unaided by sight. A rough cicatrix within the

bladder may not only act as a foreign body, but prove the nucleus upon which a phosphatic stone may concrete.

When operating in a bladder of fairly normal shape, with reasonable care, there is little risk of doing damage to the mucous membrane; where, however, the prostate is enlarged and the surface of the bladder rendered irregular by trabeculæ, elevations of its surface, and depressions in which residual urine has been lodging, the difficulties arising are not inconsiderable. The operator should be careful to ascertain that the stone or fragments when seized by the lithotrite are perfectly free, and that within the grasp of the instrument an elevated portion of the wall is not also included. In Fig. 58 it will

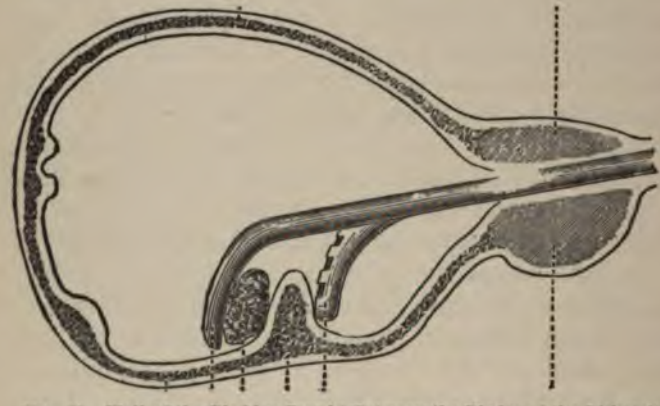


FIG. 58.—Wall of the Bladder Caught Between the Blades of the Lithotrite.

be seen that, though the female blade is in direct contact with the stone, the male blade is really in a pouch behind the enlarged prostate. This is a very deceptive position, as the operator feels that he has the fragment within the grasp of his instrument. The slight rotary movement of the lithotrite by the left hand of the operator, to which reference has been made, will invariably be found sufficient to detect this false position, before the instrument is screwed up and serious damage done.

As a rule the operator should continue to use the lithotrite so long as he can pick up fragments readily. When this ceases, or he feels that his movements are embarrassed by the presence of too much *débris*, the aspirator should be substituted, filled with plain water or boracic lotion. In using the lithotrite and seizing very large fragments, as in the earlier introductions, when the stone is hard, it is a good plan to screw it up until the resistance offered by the calculus is felt to be considerable. If the operator will then wait for a moment or so, he will often find the stone yield without further force;

in this way we may avoid putting the maximum amount of strain on the instrument. This is a matter of some importance in grasping hard stones of, say, nearly two inches in diameter. Then again, in picking up stones or fragments in bladders which are more or less pouched behind the prostate, it is convenient to alter the position of the calculus relative to the bladder before pulverizing. I sometimes say, "If you take a stone out of a hole or depression, put it on the bank to break, and then you may the more easily deal with the remaining portions of it." I have often demonstrated how readily this can be done, and how it simplifies an otherwise difficult manipulation.

In selecting evacuating tubes, the object should be to use the largest the urethra will receive, provided it can be moved about easily. In some persons the meatus is so contracted that it is necessary to incise it before a sufficiently large tube will pass. Referring to the size of the evacuating catheters, Dr. Bigelow remarks: "Thirty-one is very rarely needed, and the French sizes, 28 and 29, are generally the most convenient. For a final washing or sounding without anæsthesia, when it is desirable to give the patient the least discomfort, even so small a calibre as 26 is sometimes useful."[91] A too tightly fitting catheter may damage the deeper portion of the urethra, which is less tolerant of injury than the bladder.

I have not found a small quantity of air obstruct manipulations, for the reason that it and the stone fragments occupy opposite quarters in the bladder. If enough air enter the bladder to interfere with the withdrawal of the fragments, or to provoke spasm, it is easily displaced by disconnecting the evacuating tube from the aspirator, and making pressure with the hand over the pubes.

When using either the lithotrite or the aspirator, the bladder, even when the patient is deeply etherized, sometimes exercises a violent expulsive effort. Until this is over, all manipulations should be suspended, otherwise an accident may possibly happen. "Even deep anæsthesia," as Billroth observes, "is not always sufficient to obviate spasmodic action of the bladder."[92] When manipulating with a considerable quantity of water in the bladder, if spasm comes on, all tension should be taken off by allowing an escape to take place—a sort of safety-valve action. These are some of the points in connection with breaking the stone with the lithotrite and removing it with the aspirator. The best test for the last fragment is the suction power of the aspirator bottle, as the piece is almost sure to be felt impinging against the eye of the catheter, claiming permission to escape in a reduced form. At the conclusion of an operation the bladder should be washed out with warm boracic lotion until it returns free from discoloration with blood. After lithotrity care must be taken that the

urine is not retained beyond a reasonable time, and, if this should be the case, a catheter must be passed. Hence it is a good plan, when the stone has been removed and before the patient has become conscious, to ascertain what catheter passes most easily, which will probably be a soft one. Thus all further trouble in the selection of an instrument, should one be required, is avoided. Some surgeons leave a rubber catheter in the bladder for forty-eight hours after a lithotrity, allowing the urine to drain away continuously into a bottle in the patient's bed. If the operation has been a prolonged one and the urethra is probably sore, or if the patient is more or less dependent upon the catheter, this is not a bad plan, as it also allows of the bladder being washed out with some antiseptic lotion without disturbing the patient. In ordinary circumstances, when the operation has been simple and the bladder and prostate are tolerably normal, I have not found this expedient necessary. When the operation has been a long one and the bladder is irritable, it is well to introduce a suppository containing a grain or so of opium into the rectum before the patient is returned to his bed.

Reference will presently be made to some accidents which have occurred in the course of a lithotrity. It may, however, be well to say here that it is a good rule never to undertake lithotrity without having lithotomy appliances at hand. Unforeseen events connected with the stone, the bladder, the urethra, or the instruments, have rendered the lithotomy operation unexpectedly necessary, and by recourse to it a fatal termination has been averted. In two of my own cases, within a recent period, I know this result would probably have supervened if I had not been able to adopt the alternative without delay. In one of those instances the immediate change from lithotrity to median lithotomy was necessary by reason of a large triangular fragment becoming suddenly forced by the spasm of a powerful bladder into the membranous urethra. By the latter operation, with the aid of crushing forceps, all the stone was removed as well as the impacted fragment, and the patient made a speedy recovery. In the second instance, in performing lithotrity for an elderly man, the size of the stone felt and crushed was so out of proportion to the duration and character of the bladder symptoms, that I was sure other stones were concealed somewhere beyond the reach of the lithotrite. I therefore performed a median cystotomy, which enabled me to feel a distinct cavity, immediately above the prostate, communicating with a sac, out of which, with a pair of long forceps, I removed thirty-four fasciculated lithate stones, weighing altogether an ounce and a half.

Accidents occurring in the course of a lithotrity are fortunately rare, but some have been recorded which may be briefly reviewed.

They may be classified under three headings in connection with (1) the instruments employed; (2) the stone; (3) the soft parts.

(1) A good lithotrite may break under a strain beyond its power, but I am not acquainted with an instance of serious bending. The latter mischance would probably be more awkward than the former. The breaking of a portion of the crushing blades would most likely necessitate the immediate resort to a perineal or supra-pubic cystotomy. Dr. Vander Veer," of Albany, U. S. A., records an instance in a male adult operated on by Dr. N. L. Snow, in which the stone was large and hard, and the lithotrite broke "about half an inch from the end, leaving the portions of both blades in the bladder." Lateral lithotomy was performed, and the fragments of stone and portions of instrument were removed. The patient died on the fifth day after the operation, which is stated to have occupied an hour and a half. I have no information connected with any important bending of a lithotrite. The impaction of a lithotrite with stone, so as to render the instrument immovable, has been previously illustrated by a case of Mr. Cadge, where the difficulty was safely overcome by a supra-pubic cystotomy. To have attempted to withdraw the lithotrite along the urethra under such circumstances would certainly have been fatal. The eyes of aspirator catheters may be so firmly filled with stone fragments as to impede their withdrawal. When this is the case the instrument should be cleared by means of a stylet. Hence the importance of always having the latter at hand.

(2) It has happened in the course of a lithotrity that, by the spasmodic action of a powerful bladder, a piece of the broken stone has been so firmly jammed into the deep urethra as to render the further stages of the crushing operation either impossible or hazardous. When this is the case it is better to perform a median cystotomy, either upon the fragment thus impacted, or upon a small staff which may be passed alongside of it into the bladder, rather than to persevere with efforts to force the fragment back.

Small fragments impacted in the urethra may sometimes be removed by a pair of forceps with crocodile jaws or by gently pushing them back into the bladder, where they can be crushed. Incidentally I may mention a case recently seen in which a renal calculus was impacted behind a deep urethral stricture. The stricture was dilated under ether, by the successive introduction of Lister's bulbous metal bougies, up to a No. 12 English size. When the patient recovered from the effects of the ether, he spontaneously passed the boracic solution with which I had filled his bladder with such force as to readily expel the stone. I assume that it must have been lodged there for some little time previously, and so made a depression for itself

in the canal, otherwise it would have been pushed back by the introduction of the bougies. Large or irregular fragments, however, cannot with safety be treated in this way.

(3) In connection with the preliminary stages of lithotrity attention has been drawn to the importance of endeavoring to avoid making a simple operation a difficult one by occasioning any damage to the parts, sometimes abnormal and obstructive, through which the instruments have to pass on their way to the bladder, or in the course of their withdrawal. Any serious damage of this kind would probably necessitate a recourse to some form of lithotomy, as, if the operation of crushing could be brought to a successful issue under such conditions of difficulty and embarrassment, the prospect of eventual recovery would be considerably reduced by the complication necessarily attendant upon structural lacerations of this kind. Such complications would be likely to be more serious in their results than those usually attending the direct wound—for instance, of a median cystotomy provided with suitable drainage. Instances have been recorded when—from an unnatural thinness of its walls, from spasm, or from an undue amount of force, as, for instance, in the case of a child—the bladder has been ruptured. If the lesion is known to have occurred on the peritoneal aspect of the viscus, a laparotomy with the object of closing the rent would be indicated; whereas if it were, as in a specimen I once saw at a medical society, in the floor, a lateral lithotomy, by providing a means for immediately producing urinary incontinence, would give a chance of recovery. A lesion occurring under such circumstances is, however, seldom recognized until after death.

In reference to the immediate after-treatment of lithotrity there is not much to be said. A successful operation now leaves little more to be done than what is included under the terms warmth, rest, careful nursing, suitable diet, and a complete discharge of urine at regular intervals. If the operation is followed by some degree of local inflammation and there is reason to suspect the presence of fragments, their immediate withdrawal is the proper course to take. The possibility of such a contingency as incomplete removal must be recognized in connection with lithotrity, since some part of the bladder may be rendered difficult of access. It should not be forgotten that a stone is a foreign body which, to a certain extent, the bladder has learnt to tolerate; but a broken calculus, combined with the circumstances attending its fracture, is capable of exciting the most urgent signs of its altered shape.

After lithotrity care should be taken to see that the urine has returned to a normal condition, both in appearance and composition,

before the case is considered as completed. This is more particularly necessary in those instances where, in addition to the stone, the case is further complicated by a large prostate, a pouched or sacculated bladder, or such a state of atony as to render the patient more or less dependent on the catheter. The urine should be clear and free from evidence of shreds or masses of lymph, like feathers, since these are capable of providing not only material for decomposition, but for the aggregation upon them of phosphatic particles. A clean bladder and clear urine present conditions under which it is almost impossible for a recurrence of triple-phosphate stone to take place. Until these conditions are secured, attention to the toilet of the bladder may be required as referred to.

When after lithotrity the urine remains loaded with mucus, benefit is often derived by injecting into the bladder, with a rubber catheter and glass syringe, a watery solution of nitrate of silver in the proportion of half a grain to the ounce. Two or three ounces of this may be used and a portion left behind in the bladder, for voluntary expulsion. For a similar purpose acetate of lead, half a grain to the ounce of water, or dilute nitric acid, one or two drops to the ounce, may be employed until the excess of mucus is removed. If after a lithotrity symptoms of vesical irritation continue, such as frequent or painful urination, disordered urine, and the like, the surgeon, in his patient's interest as well as his own, will do well not to permit treatment to be concluded without a thorough examination of the bladder under an anæsthetic. Fragments may escape notice at the time of the operation, or concealed stones may be extruded into the general cavity of the bladder from pouches and depressions where the instrument could not reach, which if allowed to remain would rapidly reproduce the original state of things. This is specially of importance to remember where the prostate is more or less enlarged. Such a safeguard as this can in no way reflect on the skill of the surgeon, while the patient is protected from the possibility of an oversight. It is a provision for making doubly secure which no prudent operator or reflective patient can take exception to. Lithotrity in elderly men with enlarged prostates and partially atonic bladders is occasionally followed by a complete and permanent dependence on the use of the catheter. Some bladders positively seem better able to discharge the urine they contain when a stone is present, reminding one somewhat of the old fable of the stork and the narrow necked-pitcher.

Since the introduction of Bigelow's method of operating, the mortality as well as the period of convalescence connected with the operation have undergone considerable reduction. It is not unusual to meet with instances in which recovery may be said to be completed

within a week, even when stones of a considerable size and hardness have been removed. Without going into statistics, there is no doubt that the mortality connected with lithotrity is not only very small, but has been much reduced since the adoption of the Bigelow method. If stones were dealt with in this way when as yet small, it would be practically *nil*. Phlebitis after lithotrity is now rarely seen, owing to antiseptic precautions and improved instruments.

I think it will be generally conceded that, for all calculi of a moderate size occurring in otherwise healthy male adults, lithotrity is the treatment which will give the best results with the least risk to life. Where stones are unusually large, or complicated with disease in the urethra, prostate, bladder, or kidneys, it cannot be said that there is a consensus of opinion as to the best method of procedure. When calculus is associated, as is often the case in elderly men, with enlargement of the prostate, unless this is considerable or unusual, lithotrity is not contra-indicated, though if there is much difficulty in finding or handling the stone with the lithotrite, it may be expedient to substitute lithotomy. Under the same condition, an inability to discharge the urine from the bladder spontaneously may be a reason why it is safer to discard lithotrity. In the after-treatment of lithotrity, when the bladder is atonic or much pouched above the prostate, I make the patient lie on his belly for some time every day after the bladder has been emptied. This has often proved of service in promoting both the drainage and contraction of the pouches, and is sometimes combined with the local use of nitrate of silver as previously described.

When stone and tumor of the bladder coexist, supra-pubic lithotomy would, as a rule, be indicated in preference to lithotrity, as the former permits of the tumor being explored and removed, if this be found practicable on inspection. In a case of this kind, reported by Dr. Alexander,[24] where he performed supra-pubic lithotomy, and removed a stone from a cancerous bladder, we have an illustration of what, perhaps, is best to be done under these circumstances.

Suppression of urine after lithotrity is a serious complication, and for the most part happens in patients with unsound kidneys when the operation has been of a prolonged character. For the management of this symptom reference may be made to the subject of urethral or urinary fever. As in other disorders, where operative treatment has to be considered, advanced structural kidney disease is unfavorable both for lithotomy and for lithotrity. It is, however, a question of degree, which often requires fine balancing, and where some previous knowledge of the patient and his constitution is of assistance. Whether under such circumstances to remove the stone by lithotrity

or by lithotomy, or not to attempt either, are questions involving grave responsibility, which cannot be answered by rules having general rather than individual application. More than one case has come under notice in which I have advised, with regard primarily to the serious state of the kidneys or other vital organs, that the removal of stone should not be attempted, and have had the satisfaction of believing that the course adopted has been the means of permitting a person to live out his days with not more discomfort than surgery could entirely alleviate.

Stricture of the urethra sometimes complicates stone in the bladder. In one instance which I saw, with Dr. E. Adam of Liverpool, of a middle-aged man, where lithotrity was performed, the result was not satisfactory.

CASE.—Seven days after the operation, and when the patient had left the Infirmary, rupture of the urethra, behind the stricture, and extravasation of urine suddenly took place and caused death, in spite of incisions wherever the vitality of the tissues was threatened. Though the operation was simple, and the water in the aspirator hardly tinged with blood, it is possible that the manipulations may have further weakened a urethra which had been long diseased, and so contributed to the fatal result. Before performing lithotrity I had dilated the urethra, so that the lithotrite passed readily.

In a similar case, in which the stricture is at all tight or chronic, I should prefer perineal lithotrity, as it is not always possible to avoid the contingency to which all persons suffering from stricture are liable—namely, peri-urethral abscess and extravasation of urine, which in this instance caused the death of the patient, though it might have been entirely unconnected with the removal of the stone.

The presence of saccules or recesses in the bladder offers an obstacle in the way of lithotrity, and where they are known to exist lithotomy, as a rule, is indicated. An extensively sacculated bladder is unfavorable for lithotrity, as though by means of the latter operation the stone may be completely removed, the physical condition of the bladder is rarely thereby improved. Saccules may conceal other stones as well as lodge fragments. I saw an instructive case in the practice of my colleague, Mr. Swinford Edwards, at St. Peter's Hospital. He had crushed a stone of some size under difficulties arising from a contracted bladder and a large prostate, where considerable time was occupied. Two months afterward, all the symptoms of stone having returned, Mr. Edwards performed median cystotomy and took out of sacs communicating by small mouths with the general cavity of the bladder three large urate stones coated with phosphates. If stones are difficult to find under such circumstances with the fin-

ger and the forceps, when the bladder is laid open, how can we be surprised if they occasionally escape the reach of the sound or the grip of the lithotrite? I have previously alluded to a somewhat similar case where I abandoned lithotrity and by a median lithotomy took out of a sac above the prostate thirty-four stones weighing altogether about an ounce and a half.

On the completion of a crushing operation, the amount of fragments removed should be approximately proportioned to the size of the stone, as determined by the lithotrite. This may be estimated by putting the *débris* in a handkerchief or piece of thin linen, and then screwing it up within the folds so as to form a globular mass. Dr. Alexander [94] reports a case of stone with sacculation of the female bladder where vaginal lithotomy was performed, and subsequently ligature and amputation of the sac, with a good effect.

A few remarks may be made in reference to the employment of lithotrity in male children. Having regard to the good results obtained from lithotomy, it seems almost unnecessary to suggest any other operation. Such was my opinion until some years ago, when I happened to be examining a number of calculi removed from children which were so small as to be capable of being pulverized by one or two grips of the lithotrite. Working in this direction, and making some experiments with calculi of various size and composition, I came to the conclusion that small stones might, in male children, be readily disposed of with the lithotrite without damage to either the urethra or bladder.

Surgeon-Major Keegan [95] has added important testimony in favor of litholapaxy in male children, having practised this operation largely in India with results which have been most satisfactory. The experience of lithotomy in children has been so generally favorable that I should not feel disposed to materially extend the limit I have illustrated. Many practitioners, who are expert lithotomists, would fail to find the same success in their application of the crushing operation to male children. Some instances have been recorded [96] where the bladder was ruptured in performing lithotrity, and it is probable that we should have further examples of this if the practice were much extended.

Measures Employed for the Removal of Stone from the Bladder Other than by Crushing Alone.

In exceptional cases, operations other than lithotrity may be necessary, and I shall consider those varieties of lithotomy which at the present time are more usually selected. They include those where

the bladder is approached (1) from the perineum, and (2) from above the pubes.

Lateral lithotomy is an operation which has been extensively practised in the male at all periods of life. Recently its application has been restricted, partly by reason of the more general adoption, in some form or other, of lithotrity, and partly in consequence of certain advantages which the supra-pubic method undoubtedly possesses. In the pre-anæsthetic days, when the sufferings of the patients undergoing such proceedings required first consideration, and when speed in the performance of an operation was an important element, there was much to be said in favor of a method by which, under advantageous circumstances, the operation has been ended within a minute by the watch. This is now all changed, and other considerations have our first claim. Lateral lithotomy has much to recommend it, on the ground that it provides a ready and sufficient access to the bladder for the removal of stones of a considerable size, and at the same time enables the surgeon to satisfy himself, almost beyond question, that the whole of the stone therein contained has been removed. In addition, it secures a means for the continuous and incontinent drainage of the bladder in a convenient and dependent position for as long as it may be necessary. Mainly for these reasons, coupled with the small mortality that attends it, at all events in early life, it has obtained in the past, as well as at the present, the confidence of many surgeons of large experience in connection with this class of disorders. These are grounds for its selection which, when combined with personal dexterity and accuracy in its performance, are beyond gainsay.

The patient being placed under an anæsthetic, and retained in the lithotomy position by the crutch or anklets, a full-sized staff with a lateral groove is passed into the bladder, and held there by an assistant. In young males, in whom the bladder is an abdominal rather than a pelvic organ, it must be held more obliquely downward than in the adult; otherwise, as the curve is a short one, the extremity of the instrument may hardly be within the viscus. The bladder should contain, in the adult, at least three or four ounces of fluid, in order that the walls of the viscus may be kept somewhat apart. Previous to the operation an empty and contracted rectum should be secured. Lithotomy is one of the few operations in which from first to last there need be no change in the way the knife is held, as shown in Fig. 59. No other position permits that freedom of movement which is necessary for its dexterous performance. Commencing about an inch in front of the anus, the point of the knife should be steadily directed toward the staff, with the view of touching it in the mem-

branous urethra, below the line of the bulb, the incision being enlarged downward and outward as the knife is withdrawn, to the extent

Fig. 59.—Mode of Holding the Knife for Lithotomy.

of about two inches, or even more, so far as the superficial structures are concerned, should the size of the stone require it. It is assumed that the surgeon has been able to form a tolerably accurate notion of the size of the stone to be removed. If the incision is fully made, both in depth and direction, the staff will at once be felt by the finger of the other hand, or be so nearly bared as only to require a touch or so with the point of the knife. The bladder is then opened by cautiously pushing on the knife in the groove of the staff, the edge being directed obliquely outward, so as to incise the prostate in a direction corresponding with its greater radius.

Fig. 60.—Lack of Adaptation of Forceps to Stone.

Curved and straight pairs of lithotomy forceps should be at hand, and, in withdrawing the stone, only gentle traction forward and slightly downward is to be exercised. Angular stones, or those with spike-like processes, are sometimes more or less embedded in the walls of the bladder. When this is the case, the position of the calculus must be altered before it can be withdrawn by the forceps, otherwise the floor or neck of the bladder may be torn. I have known stones rendered stationary in this manner spoken of as being adherent to the walls of the bladder, such a connection being, of course, only a mechanical one. It is well to have one or two different-shaped forceps in readiness so as to secure a fairly accurate adaptation to the stone. Fig. 60 shows how an unnecessary amount of room may be taken up where the forceps and stone are not well fitted

to each other. A scoop and a Higginson's syringe for washing out the bladder through the wound are sometimes required when the stone breaks on being seized with the forceps. Sir George Humphry seems to have a preference for the scoop.[97] When the stone is large, too large to come away without the exercise of such force in extraction as might tear—not stretch—the neck of the bladder, a corresponding incision on the opposite side of the prostate may be made with a straight probe-pointed knife on the operator's left index finger passed fairly within the bladder, should an extension of the existing incision be insufficient. On some occasions I have thus made a bilateral incision with success. In one instance where it was employed, it permitted me to remove, without hemorrhage, a prostatic tumor (an adenoma) in addition to an oxalate stone weighing nearly three ounces.

To any one practically unacquainted with lateral lithotomy it may appear that attention to the many details it includes must necessitate some time being taken up in its performance. Such however, is not the case; and though care is to be commended rather than speed, there is nothing, in cases free from complication, to prevent the operation being safely accomplished in a few seconds. Rapidity in manipulation must, however, come naturally rather than be aimed at. The object of the operator is to extract the stone from the bladder without exposing the patient to unnecessary risk, and so long as the surgeon accomplishes this, he may regard the time occupied, whatever it may be, as well spent.

After a stone has been extracted, the bladder should be carefully searched to ascertain that it is clear. The index finger is the most trustworthy explorer, aided by downward pressure with the other hand above the pubes. If these means be found insufficient, an ordinary sound may be introduced through the wound. I usually introduce a drainage-tube through the wound into the bladder to prevent any clots obstructing the free discharge of urine. If there is considerable oozing of blood from vessels that cannot be tied, I make the tube fit accurately by the introduction of one or two sutures either above or below it. When an artery has been divided, and is evidently spouting, it must be tied; this can generally be done without much difficulty with the aid of retractors; to plug a severed vessel, if it is possible to avoid it, is to court the recurrence of bleeding. More usually I have noticed in section of the prostate and the adjacent parts that the bleeding is of an oozing nature, as if from spongy textures, but in this way many ounces of blood may be lost. For restraining hemorrhage Mr. Buckston Browne's dilatable tampon may be found serviceable.

Hemorrhage from the deep portion of the urethra, as occasionally happens after lithotomy, may also be arrested by distending the rec-

tum either by a plug or an air bag as is sometimes used with suprapubic cystotomy. Where this expedient is adopted the precaution should be taken of passing a gum-elastic drainage-tube through the wound into the bladder so as to provide an escape for the urine. This device tends to close rather than distend the wound that has been made.

As to the after-treatment of lateral lithotomy there is little to be said beyond what applies to all operations in surgery, in regard to cleanliness, drainage, ventilation, and proper feeding. The old surgeons, on visiting a patient after lithotomy, were in the habit of asking, Does he wet well? To-day we should say, How does he drain? The drainage of the wound is favored by slightly elevating the head of the bed, and the patient is to be kept dry by a good supply of ordinary or wood-wool draw-sheets. The food should be of such a character as not to require an action of the bowels for some days, the first movement, if not spontaneous, being promoted by a warm-water enema.

The chief objections urged against lateral lithotomy, apart from the fact that the operation is one entailing considerable skill in its performance, are based on some isolated cases when a fistulous tract, incontinence of urine, or sterility have followed it. When this has been the case such consequences are usually traceable, not to any fault in the original design of the operation, but to unanticipated circumstances which have arisen in individual cases entailing a greater section or distention of the parts, either with the knife or in the withdrawal of the stone. Where care is taken to provide against such contingencies by keeping the incision within the defined bounds, and the stone within the dimensions thus made for its removal, as will be referred to later in connection with perineal lithotomy, such consequences need not be apprehended. This operation was frequently referred to by the late Sir William Fergusson as "the master-handiwork in surgery."

The median operation for stone may be regarded as the simplest proceeding where the use of the knife is required. It is conducted in accordance with the direction given previously for drainage punctures, the incision being made somewhat larger so as to permit of the introduction of the lithotomy forceps and the withdrawal of the stone. After this has been done a drainage-tube should be passed into the bladder, otherwise retention of urine or a rigor is not unlikely to follow. As thus practised it is limited to small stones only, which might, as a rule, be easily disposed of with the lithotrite. It is, however, capable of being adapted to much larger calculi in two different ways: (1) by the extension of the incision so as to give more room

for whatever has to be withdrawn from the bladder; and (2) by combining it with means for crushing and evacuating the stone by this shorter route.

(1) The ordinary median operation for stone may be extended in the following manner: On the finger being introduced into the bladder as for digital exploration by perineal urethrotomy, the membranous urethra may be opened up by passing a curved probe-pointed bistoury into it, with the edge directed toward the operator, from the wound; in this incision may be included more or less of the entire thickness of the perineum. A further extension is made by passing the curved probe-pointed bistoury by the side of the finger well into the bladder. The edge is turned toward the rectum, and the floor of the prostate is divided from within outwards, commencing in the depression which more or less exists at the entrance to the urethra. The incision thus made may be extended downward to the capsule by the firm pressure of the finger. In this way as free an opening into the bladder may be made in the median line of the body as by a lateral lithotomy, and with no risk of causing hemorrhage. I believe this will be found a simple and safe way of opening the bladder for the removal of stones, which, without these modifications, could only be effected by either lateral or supra-pubic cystotomy. Further, it provides for an incontinent flow of urine from the bladder, which usually continues for some days.

(2) The second method of utilizing median urethrotomy for the removal of stone from the bladder consists in breaking the stones into such fragments as will permit of their withdrawal without any extension of the ordinary incision. Perineal lithotrity, as this operation may be called, has been referred to by Dr. Gouley,[98] of New York, in the following words: "The name of perineal lithotrity was given in 1862 by Professor Dolbeau,[99] of Paris, to an operation completed in one sitting, by which the membranous portion of the urethra is opened, the prostate and neck of the bladder dilated instead of being cut, and a large stone crushed, and the fragments immediately extracted."

The pulverization of the stone is here effected by crushing forceps, straight and curved (Figs. 61 and 62) which can be passed into the bladder through a perineal urethrotomy admitting the index finger as for digital exploration. These forceps are provided with a cutting rib within the blades. The more powerful instruments are fitted with a movable screw on the handle. The fragments may subsequently be withdrawn by aspirator catheters passed through the wound, or even by the forceps. If care is taken to make the perineal wound correspond in size with the evacuating catheters there is no difficulty in

keeping the bladder distended with fluid during the necessary manipulations.

One of the severest tests to which I have seen these crushing forceps put to was in the case of a large cystine calculus removed by Mr.

Fig. 61.—Straight Crushing Forceps.

Heycock at St. Peter's Hospital in May, 1894, by perineal lithotrity. It weighed over two ounces. The tough, waxy nature of the stone would have resisted the most powerful lithotrite and it was with some difficulty that the forceps reduced it to such pieces as were removable by this route. The patient made a good recovery.

I have selected this method in twelve instances out of over 400 stone cases requiring operation, and have so far had no deaths following it. The chief points in its favor are these: (1) It enables the operator to crush and evacuate large stones in a short space of time. (2) It is attended with a very small risk to life as compared with other operations where any cutting is done, such as lateral or suprapubic lithotomy, and is well adapted to old and feeble subjects. In a recent address, Mr. Swinford Edwards[100] shows that the latter operation for large stones has a mortality somewhere about fifty per cent. (3) It permits the operator to wash out the bladder and any pouches connected with it more effectually than by the urethra, as the route is shorter

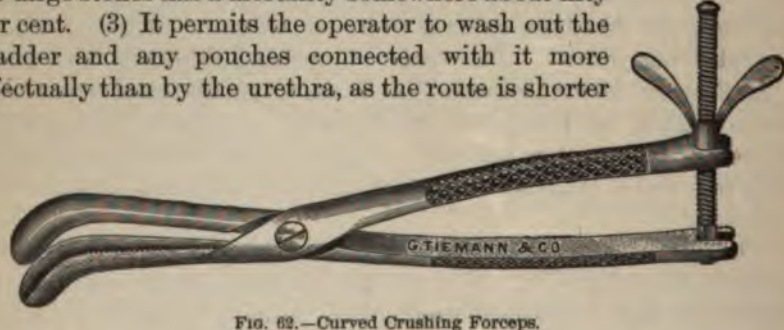


Fig. 62.—Curved Crushing Forceps.

and the evacuating catheters employed are of much larger calibre. (4) The surgeon can usually ascertain, either by exploration with the finger or by the introduction of forceps into the bladder, that the viscus is cleared of all *débris*. (5) It enables the surgeon to deal with certain forms of prostatic outgrowth and obstruction complicated with

atony of the bladder in such a way as to secure not only the removal of the stone, but the restoration of the function of micturition. (6) By the subsequent introduction and temporary retention of a soft rubber drainage-tube, states of cystitis due to the retention of urine in pouches and depressions in the bladder wall are either entirely cured or are permanently improved. To lock up unhealthy ammoniacal urine in a bladder that cannot properly empty itself after a lithotrity, is to court the formation or recurrence of a phosphatic stone. Hence the operation is well suited to some cases of recurrent calculus. I have never known the wound to remain unhealed, except in those instances where, for some reason or other, it has been desired to construct a low-level urethra.

Fig. 63.—Dolbeau's Dilator.

It is well adapted for some cases of stone in the bladder complicated with stricture in the deep urethra, as it enables the surgeon to deal with both at the same time. Nor does it expose the patient to the risk which may be attendant where lithotrity is performed with a weakened or permanently damaged urethra, as illustrated in a preceding case. Dr. Bangs[101] records a case of recurrent calculus of much interest, where dilatation of the prostatic urethra through a perineal opening was effected, for the purpose of crushing and extracting the stone, by means of Dolbeau's dilator (Fig. 63). The instrument is expanded by a screw arrangement at the handle. Commenting upon this patient, Dr. Bangs observes:

"He is able to urinate spontaneously standing, and in a full stream, and when the catheter is passed once a day for the purpose of washing there is only one, and rarely two, ounces of residual urine. This improvement in his power of urination is the result to which I wish to call special attention. During the first operation (supra-pubic cystotomy) the apparent obstacles to urination, namely, the prostatic outgrowths and the calculus, had been removed; and after the operation the bladder had been drained as long and kept as clean as after the second. But there was very little spontaneous urination, and the act was accomplished with a hesitating, dribbling stream, leaving a notable quantity of residual urine to decompose and fret an already irritable bladder. After the perineal operation, however, he was able to stand up, and almost entirely empty his bladder in a strong, full stream, with every sense of comfort. An explanation of the difference in the result must be sought for, and I

think is to be found in the enormous dilatation to which the prostatic urethra was subjected in the perineal operation. This fact has, I believe, an important bearing upon the many failures to obtain spontaneous urination after prostatectomy."

Stone in female adults and children is comparatively rare, which is probably due to the short urethra favoring the escape of a calculus at the earliest period of its formation. Concretions on foreign bodies, such as hair-pins, are not unfrequently met with, and the possibility of a stony mass having a nucleus of this kind must not be lost sight of in connection with their removal. Instances are recorded where the jaws of the lithotrite became entangled in wires and hair-pins, upon which a phosphatic deposit had taken place, during attempts made to remove the foreign body in this manner.

Where the stone is not large, removal may be undertaken by rapid dilatation of the urethra and extraction of the calculus with forceps. If dilatation is extreme more or less permanent incontinence of urine may result, a condition which is most distressing to the patient, as it is not easily remedied. As indicating the extent to which the female urethra may with safety be dilated for the purpose either of exploration or of extracting a stone, the following passage on Dr. Ogston's authority may be quoted: "Simon's statements have now been verified by general experience. Hence, since the average diameter of a man's right index finger at its thickest part is about ¾ inch (1.8 cm.), and of his little finger § inch, it may be stated that we can safely dilate the adult urethra so as to admit the index finger, and the child's so as to admit the little finger."[102] These limits should not be exceeded, otherwise a risk of permanent incontinence is incurred.

In the case of large stones, which cannot be included within the grip of the lithotrite, removal has been effected by supra-pubic or vaginal lithotomy. The latter operation consists in opening the vaginal wall of the bladder by a median incision, and, after extracting the stone by forceps, reuniting the edges of the wound by sutures, as is done for vesico-vaginal fistula, as described by Dr. J. C. Warren.[103] Dr. Galabin has recorded a case where by this operation he removed twelve large calculi and about fifty small ones from the bladder of a woman aged sixty-one. The wound was closed by silkworm-gut sutures, and at the end of ten days union was complete.[104] Vaginal lithotomy has been almost entirely supplanted by lithotrity and the high operation.

Supra-Pubic Cystotomy.

The revival of supra-pubic cystotomy is in a large measure due to the observations of Garson,[105] the practice of Petersen,[106] of Kiel,

and the advocacy of Sir Henry Thompson.[107] I propose to refer to this operation in its application to (1) stone in the bladder, (2) tumors and growths, including hypertrophy of the prostate encroaching upon the interior of the bladder, (3) foreign bodies, and (4) other conditions requiring the inspection of the interior of the bladder and drainage. In all these states, subject to some modifications, it has been applied with success. I will, first of all, describe the method of operating.

The patient may be placed either recumbent, as for an abdominal operation, or with the pelvis elevated, as in what is known as Trendelenburg's position. In the former case it was usual to distend the bladder with some ounces of water, and likewise the rectum by means of an elastic air-bag capable of inflation; the object of this being not only to make the outline of the viscus more prominent but to increase, as it is alleged, the space immediately above the pubes where the bladder is uncovered with peritoneum. Such measures are not now insisted upon, beyond retaining a few ounces of water, hardly amounting to distention. The rectum bag, in the majority of instances, is unnecessary, unless it is used with the object of enabling the operator, after the bladder has been opened, to reach the posterior wall with his finger, which in corpulent persons would otherwise be impossible. I much doubt whether the area above the pubes, uncovered by peritonæum, is increased by the combined distention of the bladder and rectum, as first proposed, unless it is practised with such an amount of force as to render the proceeding, in the case of a weak bladder, somewhat hazardous. Rupture of the bladder as well as the bowel has been caused in this way. A patient with a stricture and a distended bladder was placed on the operating table in Bellevue Hospital, New York, for the purpose of having the stricture relieved.[108] While struggling under ether the abdominal tumor suddenly disappeared, and the former area of dulness became tympanitic. At a post-mortem examination the bladder was found ruptured, without ulceration or other alteration. No doubt the distention in this case was considerable, as two quarts and a half of bloody fluid were found in the abdomen. Air has been substituted for water in distending the bladder, on the grounds that it is less likely to do injury and is calculated to render the viscus more prominent. I do not think there is much in this, and if the intestines happened to be flatulent there might be some difficulty in distinguishing the viscera. The bladder having been washed out, a few ounces of boracic solution being left within it, secured there by a ligature round the penis, and the pubes shaved, the operation may now be proceeded with. When Trendelenburg's position is selected, the patient is placed as shown in

the illustration (Fig. 64).[109] It has some advantages, as the intestinal pressure tends to gravitate toward the thorax and away from the wound. The operator then proceeds to open the bladder, by either

FIG. 64.—Trendelenburg's Position for Supra-pubic Lithotomy.

the vertical or transverse incision. In the former case, standing on the left side of the patient, he commences immediately above the bony margin of the pubis, and prolongs his incision for about two inches toward the umbilicus in the median line. This should be carried down to the intermuscular interval which is to be opened. On this being accomplished, the index finger should hook up the tissues above the upper portion of this dissection, so as to draw the peritoneal reflection toward the umbilicus. I have in this way seldom seen the peritoneum, or even been conscious of its existence. There is generally some fat and cellular tissue between the muscle and the bladder, which can be scraped away with the finger, when the anterior surface of the bladder will be seen. Care should be taken to avoid or to tie any large veins that may be met with, as they sometimes bleed freely, and have been known in elderly persons to cause secondary hemorrhage. It is a good plan to pass a handled needle, with a stout silk thread, through the bladder wall before it is opened with the knife, so as to secure it. The knife should be inserted into the bladder in the median line, and the incision made in an upward direction so as to admit the index finger; when this is accomplished it can be readily extended according to circumstances. I prefer holding the bladder wound open by a stout silk suture on either side rather than by forceps. The latter are more likely to cause a rough cicatrix afterward, which is a matter of importance. I have seen a little trouble arise by the surgeon merely puncturing the bladder with his knife, thus allowing the water to escape and the viscus to become ab-

solutely flaccid. When, for this reason, there is difficulty in finding the wound again, as is sometimes the case, a metal bulbous-ended bougie should be passed into the bladder, when the opening is readily discovered.

When it is desirable to open the bladder by a transverse incision, the opening should be made immediately above, and parallel with, the line of the pubis, which involves the division of some portion of the tendons of the recti muscles. Trendelenburg recommends that the mucous membrane of the bladder should be connected with the skin by means of temporary sutures. This incision affords a greater area of surface for doing what is necessary, and is recommended in some cases of tubercular ulceration of the bladder requiring local treatment, for plastic operations, for removing extensive growths, and for the direct inspection and manipulation of the orifice of the ureters. I have never had occasion to adopt it, except to a limited extent in conjunction with the ordinary median incision, as first described. It is stated that the transverse incision is more liable to be followed by a ventral hernia than the latter.

The bladder having been opened, I will now notice the variations necessary in accordance with the different requirements and the subsequent management of the wound. If there is a stone it is usually at once felt with the finger, when it can be withdrawn with a pair of straight or curved forceps. Care should be taken not to damage the sides of the wound. Should there be a growth or prostatic enlargement encroaching on the interior of the bladder, it can generally be felt by the finger. It can also be inspected by opaque glass or vulcanite specula of different sizes introduced through the wound as described by Mr. Hurry Fenwick [110] in conjunction with the reflection from the electric light. The latter plan is an excellent one, not only so far as seeing the growth is concerned, but also in assisting materially toward its removal. For keeping the bladder open to inspection, and at the same time occupying very little room, if the viscus is of fair capacity, Watson's spring wire speculum will be found useful. Various kinds of forceps for twisting off pieces of growth should be at hand. This, I believe, is the best method of removing masses of hypertrophied prostate or other growths. Some scoops and an enucleator hook should also be in readiness. In this way, and by other modifications which will occur to the practical surgeon, intravesical growths may be removed with a preciseness which previous to the introduction of supra-pubic cystotomy, the use of specula, and proper forceps and light, was generally unattainable. Where there is bleeding the vessels may readily be touched with some styptic, such as iron, turpentine, or the wires of a galvanic cau-

tery; whereas if the oozing is general the surface may be exposed to the action of hot water and hazeline injected through the wound. When drainage alone is required, supra-pubic cystotomy has been resorted to with much advantage.

Mr. Lawson Tait [111] has recently described a method of operating by a process of drawing up the bladder, which he describes as simple and safe. From some experience of supra-pubic cystotomy under almost all conditions for which it is applicable, I think the less we alter the relations of the bladder in removing anything from its interior the better. There is no necessity for either pushing it up from the pelvic outlet or disconnecting it from its peritoneal attachments, and I have never found the least difficulty in opening it either for stone or tumor in the way mentioned.

The object of cystotomy having been accomplished, the question arises as to what is best to be done to secure the rapid healing of the wound, should this be required. Cases have been recorded where the suturing of the bladder and superficial wound has been followed by primary union, but they are rare; on the other hand, instances are narrated where not only have these attempts failed but inflammation had followed by the confinement of urine in the prevesical space. My belief is, as matters stand at present, that a medium course is best. With this object I leave the bladder opening alone and close the superficial wound to some extent, but allow space for the use of what is generally known as Guyon's double drainage-tube. This is really two rubber catheters connected together, which give access either way either to antiseptic lotion or urine, the latter being received in a bottle by the patient's side. The dressing is then completed by gauze, wood-wool pads, and an abdominal many-tailed bandage. If for any reason I were disposed to attempt to obtain primary union by complete suture of the bladder and superficial wound, I should put into the bladder a perineal drainage-tube. One word in connection with the use of bladder sutures in these and similar operations: if they are put in, care should be taken that they are completely removed. I have known two instances where these bodies gave much trouble subsequently in causing cystitis and the deposit of a phosphatic stone. Mr. Jordan Lloyd records an instance where a calculus formed upon a nucleus of this nature was expelled *per urethram*.[112] If an attempt is made to close the bladder wound by suture with the object of obtaining primary union, the accuracy of approximation should be tested by the injection of water into the viscus.

In cases where there has been difficulty in removing a large stone through the supra-pubic incision, much damage to the bladder from ineffectual attempts to extract might have been averted by making,

in addition, an incision as for median cystotomy, by which the position of the stone could be altered with the finger from the perineal wound, while the forceps were applied through the supra-pubic opening.

Supra-pubic cystotomy has proved of much value in the treatment of stones where the operator was of opinion that they were too large for removal by crushing or in any other way. It is impossible to define by measurements what is meant by a very large stone. The term must be regarded somewhat as a relative one, in which the experience of the operator, the state of the urethra, the size of the prostate, and the condition of the bladder have to be taken into consideration. An ounce-and-a-half stone, for instance, complicated with an obstructive prostate, might, in the opinion of the operator, require a supra-pubic opening; whereas, if it had not been so complicated, a calculus twice this size, or even larger, could be dealt with by crushing. Again, the probable composition of the stone, whether a hard or a soft one, will influence the decision of the surgeon. In the same manner a conclusion may be arrived at in the case of male children; the size and nature of the calculus, coupled with the practitioner's own experience in these operations, will determine whether crushing or cutting should be undertaken.

Sacculated stones, or the possibility of such a condition, would point to the selection of the high operation. Mr. Vincent Jackson [118] reports an apt illustration bearing upon this point, where supra-pubic lithotomy was successfully performed for the removal of a lithic-acid calculus, weighing over fifty grains, which was fixed in a sacculus at the base of the bladder. Removal had previously been attempted by perineal lithotomy.

Where stone in the bladder is complicated with an enlarged prostate, and the patient is more or less dependent on the catheter by reason of atony, there are good grounds for the selection of supra-pubic cystotomy. By this means not only may the stone as well as the obstruction be removed, but the function of the bladder may be restored. It is in cases of this kind, where the patient is, or becomes, absolutely dependent on the use of the catheter after lithotrity, that calculous recurrence so frequently takes place. There can be no doubt that a complete power of contraction and evacuation is an important consideration in the selection of lithotrity. When performing supra-pubic cystotomy it is well to see that the external meatus of the urethra is not unnaturally limited, and if this is the case it should be divided. I have known an instance where such an obstruction retarded the healing of the supra-pubic incision, in the same way that an urethral stricture does, and where before the wound healed it was necessary to divide the meatus with some freedom.

Instances are occasionally met with where, for some reason, the supra-pubic opening does not close as rapidly as could be desired, and a more or less troublesome fistula results. It may merely be a case of delay, where healing can be promoted by the use of nitrate of silver, the wire of the cautery, or even the simple expedient, if the hole is a small one, of requiring the patient to exercise firm pressure over it with the finger each time urine is voluntarily passed. The retention of a soft catheter in the urethra for a few days, or the frequent passing of a catheter, are also expedients which have proved successful. In two instances where the fistula looked as if it were going to be permanent I passed a grooved staff into the bladder, punctured the membranous urethra, and put a drainage-tube into the bladder. By incontinently and continuously draining the urine in this way for some days, the fistula healed, as did subsequently the perineal puncture on the withdrawal of the drainage-tube. This plan has also been adopted as a primary part of the operation for supra-pubic cystotomy. The drainage thus provided has enabled the surgeon to close the anterior wound by superficial and deep sutures, and primary union has in this way been obtained.

The supra-pubic operation has been used in cases of stone in women with advantage, and also in both sexes for the removal of some calculi, formed on such irregular foreign bodies as hair-pins and wires which have been introduced into the urethra. Under the latter circumstances, lithotrity would be out of the question, as such attempts to retract, after breaking down the phosphatic mass covering the bodies, have been attended with serious and fatal consequences. By a supra-pubic incision less difficulty and risk may be anticipated, as should it be necessary the nucleus may be divided by a pair of cutting pliers or bone-forceps. The bladder can in women be kept moderately distended with water by the pressure of a finger on the line of the urethra until it is opened from the front. The high operation has been utilized for plastic operations, as in the case of some varieties of vesico-vaginal fistulæ.

The scar left after supra-pubic cystotomy sometimes causes inconvenience and spasms by preventing the bladder contracting down as the contents of the viscus escape. Where the scar tissue is very thick and hard the annoyance is sometimes considerable, but in other cases matters gradually adapt themselves.

The Recurrence of Stone After Operation.

I will now pass on to consider one of the most important points in connection with the history of stone in the bladder; I refer more

particularly to those instances where recurrence takes place after operation. It will be remembered by those who have watched the course events have taken, more especially in connection with the removal of stone by crushing, that though this operation had made considerable progress in many of its details a few years ago, the views of surgeons were by no means unanimous as to its great superiority over lithotomy, except in the case of comparatively small stones in bladders that were not otherwise disordered. In a discussion [1] which took place about the time when the old method of operating by numerous sittings was giving place to Bigelow's procedure, it was evident that lithotrity was not growing in favor. This was due not to any excessive mortality, or to any special difficulties connected with the operation, but to the fact that, even in the most competent hands, it failed in a considerable proportion of instances to give immunity from recurrence. Nor was there any desire to exaggerate this fact, for, as Sir James Paget observed in the discussion referred to, the proportion of relapses would have been considerably increased if the period of probation subsequent to the operation had been extended from a few weeks to at least a year. Speaking on the same occasion, Mr. Cadge remarked to the effect that it would be necessary to include the results of lithotrity under three headings, namely, those persons who were cured, those who died, and those who did not eventually recover. It was hoped that the new method of operating, which was then coming into vogue, by securing a more rapid and complete evacuation of all fragments from the bladder, would materially mitigate this acknowledged defect. Turning to the address of Mr. Cadge (1886), one of my predecessors in the Hunterian Chair at the Royal College of Surgeons, which was delivered seven years after Bigelow's operation had been introduced, and after a fair trial of the new operation in a sphere presenting almost unique opportunities for observation, we find he referred to this point in the following words: "Although the immediate and direct mortality of lithotrity is small, the recurrence of stone is lamentably frequent. In my own list of 133 cases there were 18 in which recurrences one or more times took place, being about one in seven. Sir Henry Thompson, with a much larger number of cases, gives about the same proportion. I am disposed, however, to infer that recurrence is more frequent than this."

I am not aware that the accuracy of this statement has been challenged or that anything has since arisen to question its application to what now exists. If my own experience had not furnished me with a text, I should have found it in these weighty testimonies. In proceeding to consider the circumstances under which these recurrences take place, I need hardly observe it is not with an intention of dis-

paraging lithotrity or of upholding lithotomy, but with the object of finding a remedy for defects which cannot fail to be admitted by a candid observer. The due recognition of the considerable mortality that formerly prevailed, and its probable cause, doubtless led Bigelow

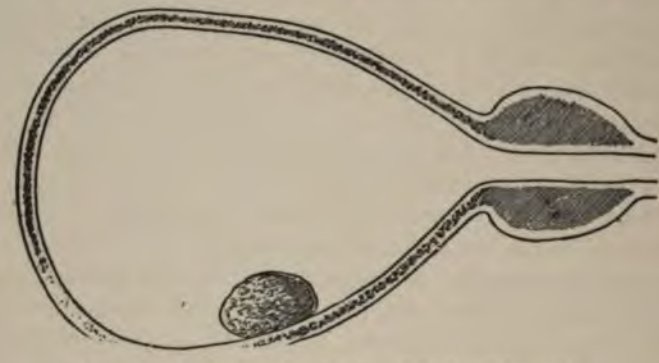


FIG. 65.—Ideal Bladder Containing a Calculus (Schematic).

in the direction of making such improvements as almost entirely to remove at one sweep the chief risk connected with the performance of lithotrity.

From a lay point of view the recurrence of stone after it has once been supposed to be removed is usually regarded as evidence that the operation performed was in some way or other defective. This conclusion is based on an idea that a calculus in the bladder always

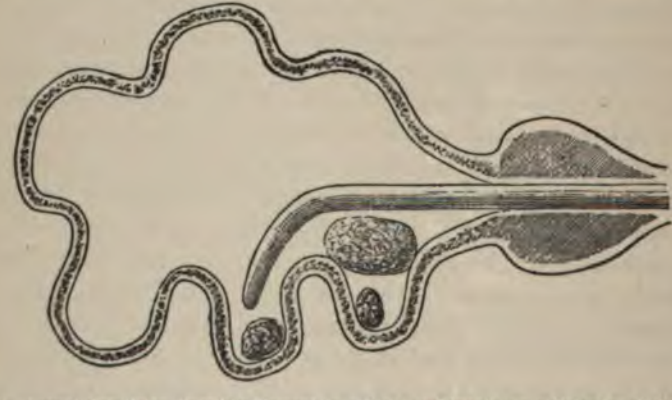


FIG. 66.—Actual Condition Possibly Present in a Bladder Containing a Calculus (Schematic).

bears some resemblance to a stone in a box, and that consequently the conditions associated with its removal are of a mechanical and constant nature. A slight acquaintance with the circumstances attendant upon operations for stone, combined with a knowledge of the

pathological changes the bladder often undergoes, is sufficient to show that such a simile is of limited application, and that other conditions often coexist which are not sufficiently taken into account. The contrast between the ideal (Fig. 65) and the real bladder (Fig. 66) containing a stone may, without exaggeration, in some elderly persons, be approximately shown in the sketches I have drawn. These may also be useful in indicating some of the different circumstances under which washing out of the bladder has to be undertaken.

Condition of Recurrence.—There are at least three forms or states under which recurrence takes place: (1) as connected with an imperfect removal, where portions of, or even whole stones are left behind; (2) the persistence of conditions favorable to the production of stone which are in no way influenced by the mere removal from the bladder of what has already been produced; and (3) the development of conditions favorable to the production of stone, conditions which had no existence prior to the removal of the original calculus. It will be necessary to explain and illustrate these several headings.

(1) That imperfect removal is an antecedent of recurrence both in lithotomy and lithotrity, rare with the former and more frequent with the latter, is a fact which is generally admitted. Putting aside those instances which may be due to somewhat hasty and imperfect methods of examination at the time of operation, I will proceed to notice some of the conditions where exceptional obstacles to complete removal are interposed, which may thus be regarded as contributing causes of recurrence. These will be found to have reference to the shape of the bladder or the prostate, rather than to anything connected with the size or the form of the stone. Where a stone lies in a normally disposed bladder the probabilities of any recurrence taking place after removal are extremely remote; for if the operator were to succeed in removing everything but the smallest particles, the local conditions are such as almost to insure their spontaneous discharge. The success of lithotomy in early life, and the gradual increase in the number of recurrences as age advances, coincident with changes in the shape of the prostate and the posterior wall of the bladder, afford evidence of this. These contributing alterations in the shape of the viscus, as forming traps for stone or fragments, may briefly be noticed.

Reference to specimens of pouched and distorted bladders will be sufficient to indicate more forcibly than words the obstacles that are sometimes placed in the way of the operator endeavoring to remove all traces of stone when it happens under such conditions. A stone in the mouth of a pouch or of a sacculus may sometimes act as a

the illustration (Fig. 64).[109] It has some advantages, as the intestinal pressure tends to gravitate toward the thorax and away from the wound. The operator then proceeds to open the bladder, by either

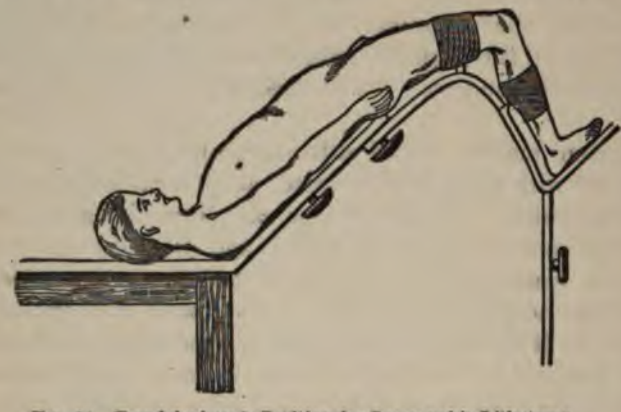


Fig. 64.—Trendelenburg's Position for Supra-pubic Lithotomy.

the vertical or transverse incision. In the former case, standing on the left side of the patient, he commences immediately above the bony margin of the pubis, and prolongs his incision for about two inches toward the umbilicus in the median line. This should be carried down to the intermuscular interval which is to be opened. On this being accomplished, the index finger should hook up the tissues above the upper portion of this dissection, so as to draw the peritoneal reflection toward the umbilicus. I have in this way seldom seen the peritoneum, or even been conscious of its existence. There is generally some fat and cellular tissue between the muscle and the bladder, which can be scraped away with the finger, when the anterior surface of the bladder will be seen. Care should be taken to avoid or to tie any large veins that may be met with, as they sometimes bleed freely, and have been known in elderly persons to cause secondary hemorrhage. It is a good plan to pass a handled needle, with a stout silk thread, through the bladder wall before it is opened with the knife, so as to secure it. The knife should be inserted into the bladder in the median line, and the incision made in an upward direction so as to admit the index finger; when this is accomplished it can be readily extended according to circumstances. I prefer holding the bladder wound open by a stout silk suture on either side rather than by forceps. The latter are more likely to cause a rough cicatrix afterward, which is a matter of importance. I have seen a little trouble arise by the surgeon merely puncturing the bladder with his knife, thus allowing the water to escape and the viscus to become ab-

years ago I cut a man for stone; just as he was about to leave the hospital he had a most acute attack of renal colic, with hæmaturia, and passed a uric acid calculus almost as large as an ordinary marble. Had this stone remained in the bladder it would probably have grown by the aggregation of phosphates upon it. It will be seen how easily I might at a later date have been exposed to the charge of having left a stone in the bladder at the previous operation. Similar illustrations of this kind of recurrence, quite independent of the selection of the operation or the manner of its performance, might easily be furnished.

(3) In the last place reference may be made to the development of conditions favorable to the production of stone which had no existence prior to the removal of the original calculus. That such is probable is indicated from illustrations of which the following is an example.

CASE.—A gentleman about 60, of a gouty habit, consulted me. I detected a moderate-sized uric acid calculus lying behind his large prostate, which I removed by crushing. When collected the fragments were entirely composed of urates with no phosphates. After some months, his large prostate began to trouble him for the first time. He found he could not empty his bladder completely, and this gave rise to more or less catarrh. Three years after the removal of the uric acid calculus he came to me again, when I found he had two stones of moderate size. These I also removed by crushing. On examination, unlike the previous calculus, they were entirely made of triple phosphates, and did not contain one particle of urates in their composition.

The mode in which triple phosphatic stone, as the recurring type of calculus, is produced is a subject of considerable interest. In a paper [15] relating to it Mr. Cadge evidently seems to connect the frequency of stone recurrence with difficulty of ensuring that every portion of the primary formation is removed from the bladder. On the other hand, he believes that structural lesions, such as those observed in connection with lithotomy, are capable of providing a nucleus on which phosphates may be deposited, in the same way as upon a nucleus of stone, provided the state of the urine admits of this. I venture to think that perhaps he somewhat underestimates the frequency with which lesions of this nature come into play in connection with lithotrity. Where the bladder is much pouched, as is the case with stones complicated with an enlarged prostate, though the bulk of the urine may be acid the contents of the sacs are often both alkaline and ammoniacal, as may be frequently noticed in cases where a residuum of urine always remains. Further, as I pointed out in my Hunterian Lectures, we do not attach sufficient importance to the influence that

has been exercised on the bladder wall partly by the presence of the stone and partly by the protracted measures that are sometimes necessary for the removal of the calculus by a crushing operation. A rough or uneven cicatrix or scar, as Mr. Cadge mentions in his paper, is not always the best substitute for a natural mucous membrane. I have often been struck with the appearance presented by the urine at varying intervals after the stone has been taken away. Masses of flocculent matter are thrown off sometimes for weeks, which are as capable of furnishing a nucleus for phosphates as a feather, a villous growth, or a rugose bladder. It may be objected that such arguments would apply with equal if not greater force to lithotomy, where the proportion of stone recurrence is considerably less. On the other hand, I would reply that the involuntary urine drainage the latter operation entails is as salutary to the inflamed, or excoriated, or distorted bladder as the drainage of pus often is to a chronic abscess; and further, that the selection of lithotrity by no means implies that less damage to the interior of the bladder is necessarily done by this process. I have examined some cases after death where lithotomy had previously been practised, at various periods of time, without being able to discover any internal trace of the procedure. Can we say the same of some cases of lithotrity where hemorrhage has been considerable both at the time and after the operation?

Because urine may be comparatively stagnant or quiescent in a saccule or pouch connected with a bladder which in other respects is healthy, it does not follow that the conditions going on within the sac are the same as when a stone is removed from such an organ by a more or less protracted, and not necessarily innocuous, proceeding. In debating this point, Mr. Cadge shows that alkaline and offensive urine holding thick mucus in excess is not sufficient to lead to the formation of phosphatic stone, by reference to the common instances where this constantly exists in connection with some forms of prostatic hypertrophy. What, however, may I ask, would be the effect of adding to these conditions favorable to the formation of a phosphatic stone, another one in the shape of constant contact with a more or less rough cicatrix, not to say anything of the presence in the urine of certain material products of inflammation capable of being demonstrated? It appears to me that there is sufficient evidence to indicate what is almost sure to follow.

Prevention of Recurrence.—From the foregoing observations some practical conclusions may be drawn under the several headings.

(1) In the conduct of all operations for the removal of stone from the bladder every care should be taken to render the process a complete one. The impossibility of doing so by one method, either

proved or rendered probable, would necessitate the selection of another. The recurrence of stone after lithotrity may indicate the propriety of an ocular or digital exploration of the bladder by some method, such, for instance, as perineal lithotrity, where the bladder and its recesses may not only be more effectually cleared of all stone and fragments, but where the viscus may be submitted, in addition, to a process of drainage. The shape of some bladders, as consequent on obstructive, mechanical, or developmental changes, is such as to render the removal of all particles almost impossible. On the other hand, where the bladder is healthy, or approximately so, the success of lithotrity can now be almost absolutely guaranteed.

(2) As the mechanical removal of a stone from the bladder does not necessarily imply that the conditions which led to its production cease to exist with the completion of the operation, states favorable to reproduction—as, for instance, in the case of diathetic stones, such as the urate, the oxalate, and even, it may be presumed, the cystine—should be carefully watched. Persons in the habit of excreting large amounts of uric acid in a crystalline form, or in the shape of renal calculi, are placed at a considerable disadvantage when the prostate commences to impede micturition and to render certain parts of the bladder dependent. Under such conditions important alterations in the amount and form of crystalline excretions may be effected by means of diet, exercise, and suitable waters. On manifestations of the diathesis continuing after the removal of uric acid calculi from the bladder, I have seen excellent effects follow the use of the Contrexeville waters in combination with other means to which reference has already been made. In some cases this seems to have been attributable to changes in the form of the excreted crystals thus artificially brought about.

(3) In the last place, much may often be done to prevent the development of conditions favorable to the reproduction of stone in some form, after its removal. This has reference more particularly to those changes in the parts which are favorable to the formation of calculi or concretions consisting more or less of triple phosphates. The urine of patients, after lithotrity especially, should be watched for some time, until, in fact, all traces, physical as well as chemical, which may be regarded as favoring such a tendency, have ceased to exist. Unless this can be brought about, the liability to recurrence must be said to continue. Urine that still contains shreds and particles of inflammatory exudation, or which is alkaline or ammoniacal, may be regarded as containing factors necessary for the formation of triple-phosphatic stones. When such conditions are constantly in existence, the completion of the process of stone formation

is often only a matter of time which some mere accidental circumstance, in furnishing what is required, may determine. By local and general means, such as those mentioned in connection with the toilet of the bladder, these conditions may be prevented. In addition to these measures, benefit will often be derived, in bringing about a more natural condition of the mucous membrane of the bladder, as well as the urinary tract generally, by the sulphur springs of Harrogate or Strathpeffer in Great Britain, or the ferruginous waters of Wildungen in Germany. Bethesda and Poland Spring waters are much used in the United States and I have reason to believe with advantage, after stone operations, particularly where there is any doubt as to the character of the drinking-water. I have not, however, sufficient knowledge of the springs on the continent of America to enable me to speak of them in detail.

Reference has been incidentally made to a paper by Sir William Roberts where it is proposed to make the lactic fermentation predominate over the ammoniacal, with the view of preventing the deposition of triple-phosphate concretions. In some cases immediate and permanent benefit appears to have resulted, though further observation will be necessary for the purpose of establishing the value of the suggestion from a practical point of view. I have endeavored, in the few instances where the treatment has been tried, to bring this about by first washing out the bladder with tepid water containing from five to ten grains of citric acid to the pint, and then, after the bladder has been cleansed in this way, leaving within it a drachm of extract of malt (bynin) in an ounce or so of water. Of the value of this treatment I have already had some proof.

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DISEASES OF THE PROSTATE.

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An exhaustive anatomical description of the prostate would not be in keeping with the character of this work, but it is almost impossible to give a practical outline of the various diseases affecting this organ without a preliminary discussion of some of the main points of its anatomy and physiology. Especially is this necessary in view of the fact that our text-books upon anatomy are notably defective in their descriptions of this particular structure. Slight attention is usually given to the prostate in the dissecting-room, comparatively few students acquiring even a superficial knowledge of its structure and functions. Without entering into an elaborate discussion of the views of those who believe the prostate to be essentially a muscle, or of their opponents who claim that it is essentially a gland, it will suffice to say that the prostate is a musculo-glandular organ, situated at the outlet of the bladder and surrounding the neck of that viscus. It lies behind the triangular ligament or deep perineal fascia and impinges upon the rectum, through the thin walls of which it may readily be palpated by the finger. The relation of the organ to the rectum is one of the most important of its gross anatomical relations, having a very important bearing upon both the symptomatology and diagnosis of prostatic disease. The close anatomical association of the prostate and rectum very often results in coincidental disturbance in both organs, through the medium of the associated nerve supply, as a consequence of disease in one or the other.

In a general way, the old description of the prostate as resembling a horse-chestnut is quite accurate, as regards both shape and size. The organ measures on the average about an inch and a half in breadth, three-quarters of an inch antero-posteriorly, and somewhat less than an inch in thickness. The prostate is supported by the pubo-prostatic ligaments, derived from the anterior vesical ligaments, the posterior layer of the triangular ligament, and the levator ani muscle. The organ presents the appearance of two moderately distinct lateral halves or lobes. The so-called median lobe is a misnomer, this structure being a pathological formation. It is not surprising that such a mistake should be quite general when authorities

state, as does one excellent anatomist, that the median lobe is a cause of obstruction in fully twenty per cent of prostates after the age of sixty. The prostate is tunnelled by the urethra and by the prostatic and ejaculatory ducts. On its floor is a longitudinal, highly sensitive, erectile structure, known as the veru montanum. This is supposed to be the principal seat of sexual sensibility. Upon either side of the veru montanum is a longitudinal depression, the prostatic sinus, into which open the prostatic ducts, some fifteen or twenty in number. At the anterior extremity of the veru montanum are situated the mouths of the ejaculatory ducts one upon each side. Just in front of the veru montanum is a depression known as the uterus masculinus or prostatic utricle, from its supposed homology to the uterus. The prostatic urethra does not traverse the prostate in the same manner in all individuals, the roof of the canal being barely covered in by prostatic tissue in some cases. It does not always begin anteriorly in the centre of the prostatic apex, being occasionally deflected to one or the other side, as shown by specimens in the possession of the author.

The length of the prostatic urethra and the direction of its curve vary greatly. In the average adult it measures about an inch and a quarter in length. Its curve is quite sharp and short in the child, is longer and more gradual in the adult. A knowledge of the normal curve of the prostatic urethra is of great importance in diagnostic explorations of the canal, inasmuch as pathological conditions of the organ or the tissues about the vesical neck produce alteration in the conformation or length of the prostatic urethra. The structure of the prostate differs somewhat in children and adults. The assertion has been made, and accepted, in certain quarters that children have no prostate. This, however, is incorrect. The difference between the child and the adult is mainly in the direction of the relative proportion of glandular and fibro-muscular elements. Even in very young children the muscular elements of the prostate are sufficiently abundant to give a sharply defined and prominent character to the organ. The glandular and fibro-connective-tissue elements, however, are not so abundant and well marked as in the adult. The veru montanum, ejaculatory ducts, and mouths of the prostatic follicles and the seminal vesicles—which are so closely associated with the prostate and its functions—are capable of definite demonstration even in young infants. The argument has been advanced that children really have no prostate, because, its function being purely sexual, there is no occasion for its development until such time as the sexual power manifests itself. This argument is not particularly logical, in view of the fact that the seminal vesicles and veru montanum, which are

perhaps of more importance from a sexual standpoint than the glandulo-muscular elements of the prostate, are disproportionately developed in infants. A superficial dissection shows that in spite of all argument very young children have well-developed prostates, a sparsity of the prostatic glandular tissue to the contrary notwithstanding. In a general way, however, it may be asserted that the prostate is of no great functional importance until the period of puberty arrives. Whether its muscular tissue is of importance in the function of micturition, thus rendering the organ to a certain extent a urinary one, is a question which has excited much controversy. In the author's opinion, while urination might be carried on in the absence of the muscular tissue of the prostate, the organ nevertheless appears to have a distinct part in the physiology of micturition. While admitting, then, that the prostate is to all intents and purposes a procreative organ, it would seem that it is a participant in the function of micturition and should, therefore, receive consideration as a urinary organ as well.

In infants the muscular structure of the prostate is practically continuous with the muscular structures of the vesical walls. As the subject grows older a certain amount of circumscription and reinforcement of the prostatic muscular tissue seems to occur, so that there is a more distinct line of demarcation between the prostatic and vesical muscular tissue, although the circular fibres of the prostate are still continuous at the outlet of the bladder with the false sphincter of that organ.

On section the prostate is of a pale reddish color, rather dense and firm, and quite friable, the fibro-muscular elements being contained in a proper fibrous capsule. The impression derived from the usual descriptions of the prostate is that its glandular and consequently its most important elements from a functional standpoint are contained within the proper fibrous capsule of the organ. This, the author is convinced, is an error. The principal glandular elements of the prostate are outside the circumscribed structure which we know as the prostate body proper, in the tissues surrounding the prostate, seminal vesicles, and neck of the bladder. The glands and ducts are numerous and form the tissue mass of which the seminal vesicles constitute the most important part. This tissue is richly supplied with nerves and blood-vessels. A consideration of this particular feature of the anatomy of the prostate serves to explain the obstinacy of infectious diseases involving this organ. It lays peculiar emphasis upon the oft-repeated assertion of the intrinsic incurability of gonorrhœal infections of this part. A careful dissection of the prostate and its associated glandular structures about the neck of the bladder

is very interesting to those who believe that deep gonorrhœal infections in the male are to be speedily cured by instillations of a few drops of nitrate of silver solution into the prostatic urethra.

The muscular elements are arranged in a circular fashion forming posteriorly a rather distinct muscular ring, constituting the dividing line between the vesical cavity and the true vesical neck, *i.e.*, the prostatic urethra. This ring of circular fibres constitutes the internal or false sphincter vesicæ. Anteriorly the muscular fibres of the prostate are continuous with the accelerator urinæ muscle surrounding the membranous urethra. It would be difficult to say whether or not the false sphincter vesicæ is a part of the muscular structure of the vesical wall, or of the prostate. The question is of no great moment, inasmuch as there is practically a structural and functional continuity between the prostate and bladder muscle even in the adult. The tendency has been rather in the direction of a too arbitrary differentiation between the two organs, a differentiation which is hardly warrantable from a physiological standpoint, except in so far as the sexual function of the prostate is concerned.

The circulatory supply of the prostate is very abundant. The arteries are derived from the internal pudic, hemorrhoidal, and vesical. The veins form an elaborate and intricate plexus about the organ, inosculating with those supplying the rectum and anus in a very intimate manner. This peculiar relationship of the vascular supply of the rectum, anus, and prostate explains to a certain degree the close pathological relationship of these structures. Thus hemorrhoids, constipation, and hepatic obstruction are liable to lead to passive congestion of the prostate, and even predispose to active inflammation. Conversely, inflammatory and congestive disturbances of the prostate are apt to produce rectal tenesmus, hemorrhoids, or even proctitis. Thompson has called attention to the fact that the veins of the prostatic plexus are prone to become tortuous and varicose in elderly subjects. This condition of the veins is often associated with a similar condition of the hemorrhoidal vessels.

The nerve supply of the prostate is derived mainly from the hypogastric plexus. The organ is most liberally supplied with filaments from the sympathetic. This sympathetic supply is closely associated with that of the rectum and anus, a relationship which in some cases forms another strong link of pathological connection between the two organs. By a consideration of the nerve anatomy of these parts we are able to understand the strangury, spasmodic stricture, and retention of urine which not infrequently occur as a result of operations about the rectum and anus. The elaborate sympathetic nerve supply of the prostate, and particularly of the prostatic urethra, is explana-

tory of the more or less remote reflex disturbances, both mental and physical, that so frequently occur as a result of prostatic disease. By means of the sympathetic nerve supply the prostate is brought into most intimate relations with all the organs in the function of which the sympathetic ganglia play an important rôle.

The sexual function of the prostate is rather a complex one, being made up of several elements, namely, special, sensory, secretory, and mechanical. We will leave its urinary rôle out of consideration for the present because the urine may be physiologically retained or expelled independently of the existence of the prostate. The prostatic urethra, and especially its floor in and about the veru montanum, is the seat of the urinary *besoin* and the pleasurable sensation experienced in the performance of the sexual function. The prostatic follicles secrete a milky fluid, slightly acid in reaction, the function of which is to dilute and increase the bulk of the seminal fluid. The muscular fibres of the prostate are involved in the convulsive, spasmodic muscular action which expels the semen during ejaculation. This is brought about by a distinct reflex contraction excited by the over-distention of the prostatic urethra with seminal fluid at a time when the nerves of sexual sensibility are in a condition of relative hyperæsthesia.

Standard authorities upon anatomy assert that the follicular prostatic glands in some old subjects contain small calculi, composed of carbonate of calcium and animal matter. This assertion is based upon the fact that it is practically only in old subjects that these calculi are of sufficient size or so located as to give rise to mechanical disturbance. The author has become convinced from the dissection of a large number of prostates in subjects under middle age, that prostatic calculi are frequently found in young subjects. If the examination of the prostate be restricted to the tissue immediately surrounding the prostatic urethra, these calculi will not frequently be found. If, however, the glandular tissue outside of the capsule proper—*i.e.*, the glandular tissue surrounding the base of the prostate and neck of the bladder—be carefully examined these calculi will often be met with. The author has found them in the tissues surrounding the neck of the bladder an inch and a half or more above the base of the prostate proper.

Attention has frequently been called to certain striking points of similarity between the prostate and uterus, from both an anatomical and a physiological standpoint. It is unnecessary to go into an exhaustive discussion of this subject. It is, however, well to remember the existence of a general resemblance between the two in the clinical study of diseases of the prostate. This is especially true with reference to the consideration of surgical measures of relief of

circumscribed neoplasms, and to the medical treatment of congestive and inflammatory affections of this organ. The prostate is of necessity a more obscure field for research than the uterus, hence analogical reasoning is sometimes of great clinical and therapeutical value.

Anomalies of Development.

Congenital anomalies of the prostate are rare, at least from a clinical standpoint. It is probable that they are more frequent than is generally supposed, but from the fact that they are not likely *per se* to prove of pathological importance, they are not often brought to our attention. Defective development incidental to extreme degrees of hypospadias and epispadias are occasionally seen. In these extreme cases the prostate is usually distinguished by its absence. The anomaly requires no consideration excepting such as is incidental to the deformity of which it is a part. Defective development of the prostate is quite frequent and is associated as a rule with defective development of the sexual apparatus as a whole. The prostate is apt to be wanting in cryptorchids. In certain cases of sexual perverts, and in individuals who are imperfectly developed and imperfectly differentiated from a sexual standpoint, the prostate remains undeveloped, this lack of development being both muscular and glandular, as might be expected from the rudimentary condition of the other portions of the sexual apparatus. The inhibition of prostatic growth is due not to a failure of the individual to perform his sexual functions in a normal manner, but to an inhibition of development which may be more or less general, and which always involves all the component parts of the sexual apparatus.

That imperfect or exaggerated development of the prostate occurs alone is possible, but this is a question which for obvious reasons is extremely difficult of solution. It would seem that aberrations of development of a functionally very important structure of the prostate, viz., the veru montanum, are possible. Independently of the existence of infectious or inflammatory disease, cases of imperfect or exaggerated development of this structure probably occur. It would be difficult, however, to eliminate in such cases the effects of masturbation and sexual excess. Stricture of the prostatic urethra is asserted by so excellent an authority as Thompson to be an unknown condition. The author has several specimens in which distinct bridles of an apparently congenital character are seen to be present in the anterior portion of the prostatic urethra. Some other specimens in his possession show an abnormal narrowing of the prostatic urethra at its junction with the *pars membranosa* and a distinct lateral

deviation of the canal. In several specimens the prostatic urethra, instead of tunnelling the centre of the apex of the prostate, diverges to such a distance from the median line that obstruction to the passage of instruments must almost of necessity have been experienced during the life of the patient, had such instrumentation become necessary. It will be readily understood that these conditions of abnormal narrowing and deviation in all probability produced no disturbance, inasmuch as there were no evidences of disease of the mucous membrane to be found. Should such a canal, however, become infected with gonorrhœa, a far different state of affairs would be instituted and considerable trouble might result from the congenital conditions present. The author is inclined to believe that such congenital deformities of the prostatic urethra may be responsible for the difficulty experienced in instrumentation in some cases of urethral disease.

Injuries of the Prostate.

Traumatism of the prostate, aside from that incidental to surgical operations and manipulations, is exceptional. Contusions and laceration of the prostate due to direct force from falls or blows are especially rare on account of the situation of the organ, protected as it is by the pubic and ischiatic rami and the ischial tuberosities. The force of falls and blows upon the buttocks is usually broken by the prominent osseous parts. Blows upon the perineum are not likely to injure the prostate on account of the distance of the organ and the elasticity of the musculo-cellular cushion constituted by the tissues of the ano-perineal region and ischio-rectal fossa. Accidents have been known where the membraneous urethra has been torn completely across at the apex of the prostate, and yet that organ has escaped injury. This was long ago noted by Chopart. A crushing injury involving the prostate is almost necessarily fatal, excepting where the prostate is injured indirectly through the medium of fracture of the pelvic bones fragments of which wound the organ. In cases of extensive crushing injury the traumatism of the prostate is comparatively a minor consideration. Incised, punctured, and lacerated wounds of the prostate from accidental injury are occasionally seen. Sharp bodies may be driven into the perineum, the patient perhaps falling astride them. Most of the accidental injuries are due to a fall upon some pointed object. Dugas cites a case in which the branch of a tree was driven into the perineum and the prostate wounded (Forge, "Traité de Chirurgie"). Velpeau reports a similar case in which a wooden stake was driven into the perineum. Brittle substances introduced into the rectum have been known to penetrate the prostate.

Obviously such penetration might occur with great facility. Injury to the prostate by firearms is necessarily very rare. Ricord, however, reported a case in which a musket-ball penetrated the false pelvis, passed downward along the iliac fossa, entered the true pelvis, and penetrated the prostate. It was detected by a digital examination through the rectum and extracted by perineal section. Wounds of the prostate inflicted in the performance of surgical operations of various kinds are frequent. It is necessarily wounded in all of the perineal operations of lithotomy with the exception of the simple median or Marian operation. It is often wounded in perineal urethrotomy, and is invariably wounded in the proper performance of perineal puncture for drainage of the bladder. Operative wounds of the prostate are not dangerous *per se*, unless the incision or laceration, as in the case of extraction of too large a stone, extends beyond the bounds of the fascial investments of the prostate, thus involving the pelvic cellular tissue or peritoneum. The prostate is often injured from its urethral aspect in the passage of the catheter or sound, or in the performance of that extremely hazardous operation, internal prostatotomy. These forms of prostatic trauma are exceedingly dangerous because of the exposure of the injured tissue to sepsis and the necessarily imperfect drainage. An additional element of danger is uncontrollable hemorrhage. These factors are done away with in perineal or suprapubic operative wounds of the prostate. Another danger is the formation of a false urinary passage. False passages traversing the prostate and beginning in the prostatic urethra, or at some point in the urethral walls at a greater or less distance anterior to the apex of the organ, are very frequently seen. Instances have been known in which a catheter or sound has been passed through the urethral walls at some point in front of the bulbomembranous region and made to traverse the tissues outside of the urethra, penetrating one or the other lobe of the prostate, thus reaching the bladder by a roundabout and most dangerous route.

Results of Injury.—As already suggested, wounds from the interior are most likely to be followed by serious results, providing the injury be limited to the prostate itself. Lacerations and contusions are more dangerous than smooth incisions, excepting in respect to the danger of hemorrhage, which is obviously greater in clean incised wounds, unless such wounds be external and open.

In considering the question of hemorrhage from operative or accidental wounds about the prostate, it is well to remember that the region of the prostate is very vascular and rather difficult of access for the application of methods of hæmostasis. Retention of urine from congestive or inflammatory occlusion of the urethra, or from

complete or partial obliteration of the canal as a result of the traumatism, is likely to be the next point for consideration in prostatic injuries. Pyogenic infection and abscess, possibly followed by urinary fistula, and septic cellulitis, are serious results which are likely to occur in extensive injuries, especially those in which drainage is imperfect. The septic cellulitis may be limited to the ano-perineal region and ischio-rectal fossa, or may extend over a large area of the subcutaneous and intermuscular planes of cellular tissue. In case the wound extends beyond the bounds of the prostate, septic pelvic cellulitis or general peritonitis may supervene, these latter conditions being intrinsically fatal. Constitutional manifestations of septic or pathogenic intoxication may supervene. It will be observed that, in a general way, the conditions produced by, and dangers of, prostatic injuries are essentially the same as in traumatism of the urethra and bladder.

Symptoms.—There is nothing characteristic in the symptomatology of wounds of the prostate. In a general way, they are similar to those of deep urethral traumatisms. The principal symptom produced by the injury is urethrorrhagia, providing the wound of the prostate communicates with the urethra. If an open wound of the prostate exists and the urethra be injured, the hemorrhage occurs at the site of the injury and also in the form of a urethral hemorrhage. Retention of urine has already been alluded to, and is an important factor in the symptomatology of prostatic traumatism. If the extravasation of blood into the surrounding tissues be extensive, hæmatoma may result, which may be felt by way of the rectum, around which viscus it may burrow for a considerable distance. The local and constitutional symptoms which speedily follow serious injuries of the prostate are by no means distinctive, but are precisely similar to those which follow urethral injuries producing urinary infiltration, cellulitis, or abscess.

Treatment.—Operative wounds from the exterior require no special consideration. In both internal and external wounds which are not extensive, and in which a catheter can readily be passed, a full-sized soft instrument should be introduced into the bladder and retained from three days to a week or more according to the progress of the case. Great care is necessary to maintain urethral asepsis. If the hemorrhage be excessive and urinary extravasation exist, or if there be any reason to believe that the wound of the prostate is of a serious character, or in any case in which the catheter does not pass readily, a free perineal section should be made and the bladder drained by a large tube, the after-care of the case being based upon strict principles of antisepsis. In cases in which the perineum is ex-

tensively disorganized by the injury and it is a difficult matter to find the proximal end of the urethra, suprapubic cystotomy, retrograde exploration, and perineal incision should be combined. Through and through drainage should be instituted in such cases. In the author's opinion this procedure is far safer than a prolonged and necessarily haphazard search for the normal channel *via* the perineum. Infiltration of urine demands free incisions in any and all situations in which intumescence of the tissues is suggestive of the presence of extravasated fluid. The incisions can hardly be too free or too numerous—with due respect to anatomical dangers. The same principles should be adopted in the management of urinary abscess and cellulitis. The early and free use of the knife in septic cases is the only hope of saving the life of the patient. The tendency to asthenia, incidental to the profoundly depressing influence upon the sympathetic nervous system produced by injuries of this region, and the great danger of toxæmia, constitute a direct and positive indication for free and liberal supportive measures of a dietetic and stimulating character.

Neuroses of the Prostate and Reflex Neuroses of Prostatic Origin.

When we consider the abundant nervous supply of the prostate and its environs, and especially its liberal endowment with sympathetic nerve filaments, with its resulting intimate association with the rectum, bladder, and other viscera, it is by no means surprising that nervous phenomena of various kinds, referable directly or indirectly to disturbance of the prostate, should occur. It is true that many neurotic disturbances which the author believes should come properly under the head of neuroses of the prostate have their origin primarily in demonstrable organic disease. The clinical fact, however, remains, that pronounced nervous disturbance, such as direct or reflex pain, and in some instances considerable psychical disturbance may persist and constitute the principal source of disquiet long after the primary organic cause has completely or in great measure subsided. In either case the primary condition is of so little moment that there would be little or nothing to attract the attention of the physician were it not for the disproportionate nervous disturbance which results.

In using the term neurosis, the author is well aware that a certain element of ambiguity must necessarily enter into the consideration of the subject, but in the present state of our knowledge of disease, in the light of practical clinical experience, and more especially to

subserve the purposes of an intelligent therapy, it would seem that the term neurosis is sufficiently clear and comprehensive.

In considering neuroses of the prostate, there are four points to be borne in mind: *First*, the physiological and anatomical analogy between the prostate taken as a whole and the uterus. *Second*, the relation of the prostate to the function of urination. *Third*, the sexual function of the prostate. *Fourth*, the intimate association of the prostate with the rectum, anus, seminal vesicles, urethra, and bladder.

Neuralgia and Hyperæsthesia.—Neuralgia of prostatic origin, unattended with evidences of organic disease or associated with very slight organic changes, is by no means rare. It is probable that a certain degree of hyperæmia exists in by far the majority of cases of prostatic neuralgia, yet a disturbance of the circulation does not seem to be absolutely necessary in such cases. Hyperæsthesia of the prostate is usually limited to its urethral portion and is very frequently met with. Hyperæsthesia and neuralgia are often associated, the former being the more likely to exist alone.

The causes of neuralgia and hyperæsthesia of the prostate are: (1) Sexual excesses and masturbation. (2) A gouty or rheumatic diathesis; this constitutes a very potent predisposing factor. (3) Traumatism of the prostate, surgical and accidental. (4) Acute or chronic congestion from various causes. (5) Acute or chronic inflammation of infectious origin. (6) Urethral disease, notably stricture. (7) Foreign bodies or tumors in the bladder. (8) Psychical disturbance with an attendant element of mental suggestion incidental to, (*a*) ignorance of sexual physiology and the influence of quack literature; (*b*) injudicious and perhaps unnecessary treatment of the sexual organ under suspicion; or, (*c*) the prolonged duration of mental disturbance produced by actual organic disease. These cases are especially liable to be associated with hyperæmia. Prostatic catarrh is also a frequent concomitant.

It would be difficult to disassociate the local irritation produced by highly acid urine in gouty and rheumatic patients from the exaggerated nervous sensibility produced by the constitutional effects of lithæmia. Many cases are found, however, in which neuralgic pain, referable to the perineum, anus, neck of the bladder and urethra, is experienced by lithæmic patients in whom the correction of the acid and irritating properties of the urine is not followed by appreciable benefit until alkaline and anti-lithic remedies have had sufficient time to appreciably modify the diathesis present. The author has under observation at the present time the case of a gentleman forty-five years of age, who has been for some years annoyed by neuralgic pain of the kind described, associated with intense hyperæsthesia of the pros-

tatic urethra. He is particularly annoyed by persistent erections at night, and irrespective of the reaction of the urine the act of urination gives him considerable pain. Careful examination of the bladder and the urethra by means of the endoscope, cystoscope, and mechanical exploration fails to reveal any organic condition which will explain his symptoms. There is apparently no disturbance of the kidneys which might by reflex irritation constitute the etiological factor in the case. As far as can be determined, the origin of the difficulty in this patient was a gouty constitution associated with strictures of large calibre. The latter were operated upon by the author some years ago with perfect success in every respect, save in the failure to ameliorate what to him appeared to be the most annoying condition. Similar symptoms are often produced by rectal or anal irritation, but this was not present in this case. Pain of a neuralgic character, referable to the perineum and neck of the bladder, and perhaps radiating into the testes, is by no means an unusual feature of disease of the lower bowel. This is a point worthy of remembrance.

Cases of neuralgia of the prostate following operations upon that organ, or operations upon the bladder involving it, are occasionally met with. The author has at the present time under observation a case in which he operated through the perineum for the purpose of draining the bladder in a case of obstinate cystitis in a young adult. The result was perfect as far as the cystitis is concerned, but the patient has been tormented ever since the operation by ano-perineal pain and crural and testicular neuralgia. There is no condition of the prostate, bladder, or rectum which will serve to explain the difficulty. Another case is that of a man operated upon for large-calibred stricture of the penile urethra, in whom there have existed for some years a persistent, deep-seated, intermittent perineal pain, frequent urination, and marked hyperæsthesia of the prostatic urethra. Careful exploration failed to detect any morbid condition which would serve to explain the trouble. The operation of urethrotomy, while perfectly effective as far as the stricture was concerned, completely failed to relieve the prostatic neuralgia.

Acute or chronic hyperæmia of the prostate is responsible for some cases of hyperæsthesia and neuralgia of this organ, and in such cases the perturbation of the blood supply is really the essential condition. Unfortunately, however, the pain is not only the most prominent feature in such cases in the mind of the patient, but it often persists in spite of all measures tending to correct the circulatory disturbance. That a strong psychic element enters into these cases, as indeed it does in the majority of cases of genito-urinary disease, is admitted. Psychical disturbance, as indicated in the etio-

logical table already given, may be the starting-point not only of vascular disturbance attended with neuralgia and hyperæsthesia, but may produce neurotic disturbance independently of disturbances of the circulation. Prolonged and unnecessary treatment of the prostatic urethra is not only likely to produce a hyperæsthetic condition of this part, but also persistent and obstinate psychical disturbance, perhaps amounting to hypochondriasis or even melancholia, with or without painful sensations, real or imaginary—in this region. Hysteria in the male from this cause is by no means as infrequent as is ordinarily supposed.

Psychoses from prostatic irritation are very frequent, but care must be taken to carefully discriminate between those cases which are psychical *ab initio* and those in which the psychical element is simply an ingraft upon the symptoms produced by organic disturbance. Acute or chronic inflammation of infectious origin is of course the most frequent condition, but many cases occur in which, after the inflammation has disappeared, neuralgic pain referable to the neck of the bladder and radiating into the perineum, testes, thighs, and rectum, persists in spite of all treatment, often perhaps because of it. Reflex irritation produced either from the vesical or urethral side of the prostate is quite often seen. Urethral and perineal pain, associated with stricture and stone in the bladder, are familiar examples. Stricture of the urethra occasionally produces neuralgia referable not only to the prostate, but apparently involving the entire bladder. A case at present under treatment demonstrates this clinical fact to excellent advantage. A gentleman, thirty years of age, suffered from pain in the region of the bladder associated with frequency of micturition, for six or seven years. He had been operated upon for stricture some time prior to the beginning of his neuralgic pain, and he was inclined to attribute the disturbance to the urethrotomy. Examination revealed several strictured bands of large calibre which had evidently escaped the original operation. A second urethrotomy was advised and performed with perfect relief of the patient's symptoms. A peculiar feature in this case was severe hypogastric pain whenever the urine was held for several hours. This has completely disappeared since the operation.

The term hyperæsthesia of the prostate should comprehend those cases of so-called vesical irritability which have been described by some authors as neuralgia of the vesical neck. The more important and highly sensitive parts involved in the sexual and urinary functions are integral parts of the prostate. The prostatic urethra derives most of its importance (save that incidental to its function as an outlet from the bladder) from certain anatomical and physiological

peculiarities of the prostate proper. The elaborate and highly sensitive nervous supply of the prostate is the seat of urinary desire. The nervous supply of the prostate is also responsible by virtue of special nervous filaments—supplied chiefly to the caput gallinaginis—for the voluptuous sensations incidental to the performance of the sexual function. Hyperæsthesia of the prostate manifests itself in two ways. First, by heightened sensibility of the prostatic urethra to the pressure of urine with resultant frequent micturition. This is associated perhaps with an inhibition of the function of the false vesical sphincter, as a consequence of which the urine enters the highly sensitive prostatic urethra at more frequent intervals. The capacity of the bladder itself is in all probability diminished by reflex irritation of the nervous supply to the vesical muscle. A careful consideration of the physiology of micturition readily explains the so-called vesical irritability resulting from prostatic hyperæsthesia. The sexual function of the prostate is likely to be profoundly disturbed by hyperæsthesia of the organ, particularly if the region of the caput gallinaginis be involved. Nocturnal pollutions, imperfect erection, and premature orgasm, or perhaps complete *impotentia coeundi* may result, these conditions being by no means readily amenable to treatment.

Treatment.

The neuroses of prostatic origin constitute a most emphatic indication for attention to genito-urinary hygiene. Careful regulation of diet, attention to the various emunctories of the body, and most careful supervision of the sexual habits of the patient are the keynote of treatment. Remedies calculated to correct lithæmia are essential in appropriate cases. Regulation of the diet, however, is of prime importance in such cases. Tobacco and liquor are especially to be interdicted. Certain sedative remedies are often of great value. The bromides, camphor—or a combination in the form of the monobromide of camphor—and gelsemium are of especial value, the latter remedy perhaps being the most reliable of any at our command. Ergot is often of great service. Cold sitz-baths and enemata often give great relief. Careful attention should be paid to the condition of the bowels. Strong cathartics should be avoided and mild laxatives given. The local measures of relief are as numerous as they are unsatisfactory. In some cases in which there is a strong psychic element, a cold sound or the psychrophore is of great value. Should a certain degree of actual organic disease of the prostatic urethra exist, however, these measures may produce more harm than good. In some cases the nervous make-up of the patient is such that

local treatment simply serves to direct his attention to the part with resulting exaggeration of his symptoms. In cases where there is actual disease of the mucous membrane of the prostatic urethra, the judicious application of nitrate of silver by means of the deep urethral syringe or the endoscope is of value. The author, however, takes this opportunity of stating that deep urethral injections have probably been productive of more damage in this class of cases than in any other which could be mentioned. Many cases of neuralgia and hyperæsthesia of the prostate, in which there primarily existed no pathological change whatever in the deep urethral mucous membrane, are treated so assiduously by deep urethral injections that the erroneous diagnosis of actual disease of the prostatic urethra is made good by the development of genuine pathological conditions under the irritating influence of the local applications. It appears very illogical in cases in which careful local examination and conscientious urinalysis fail to show the existence of organic disease of the genito-urinary organs, to treat the prostatic urethra by frequent deep injections of nitrate of silver solution in the attempt to cure a posterior urethritis, which exists only in the mind of the practitioner until it has been developed by the treatment itself. The readiness with which the diagnosis of posterior urethritis—which happens to be the prevailing fad—may be made, and the ease with which one may supply himself with the necessary instruments for deep urethral injections, constitute a constant menace to many patients who have genito-urinary disease, real or imaginary. In cases in which actual organic disease exists, the first duty of the surgeon is to institute appropriate measures for its removal. While it is best from a psychical standpoint to impress the patient with the radical result expected to accrue from the treatment, the surgeon should remember that even after the original organic difficulty has been cured the neurosis may remain. The experience derived from the removal of the original cause in reflex neuralgias in other situations has been that the neuralgia frequently persists in spite of a radical operation for the removal of the offending part. The same argument applies to neuralgia and hyperæsthesia of the prostate.

Hyperæmia of the Prostate.

The line of demarcation between prostatic hyperæmia, active or passive, and true inflammation is often rather indefinite. From a pathological, and more especially from a clinical, standpoint, there are, nevertheless, many cases of prostatic disease which fall rather under the head of active or passive hyperæmia than of actual inflam-

mation. That conditions of hyperæmia predispose to, and are likely to terminate in, true inflammation, is well understood even by the tyro in medicine. Especially is this true of prostatic diseases involving local disturbances of circulation. This proposition is, therefore, taken for granted as a preliminary to the discussion of prostatic hyperæmia. In perhaps the majority of cases of acute prostatic disease which fall under the observation of the practitioner, the diagnosis of prostatitis, acute or chronic, is made and allowed to pass without question. That no harm results therefrom in the majority of cases is simply due to the fact that the principles of treatment are essentially the same in both conditions. In some cases, however, there is little doubt that a true appreciation of the conditions present would be of direct benefit to the patient, as in certain cases of passive congestion from venous obstruction. Measures calculated to relieve passive hyperæmia are likely to prevent the development of true inflammation.

Active prostatic hyperæmia has its point of departure, as a rule, in disturbance either of the sexual function, or of the physiological act of micturition. The prostate is, from time to time, the seat of physiological hyperæmia, as is true of all glandular organs. This attends sexual excitement, however such excitement may be produced. Under normal conditions the circulation resumes its normal status as soon as the source of excitement has been removed. The return to its normal circulatory condition is still more rapid when the sexual function has been performed in a normal manner. Prolonged excitement without gratification is perhaps the most prolific source of prostatic hyperæmia. Frequent masturbation and sexual excess will also produce marked circulatory excitement of a more or less permanent character. The periods of rest between the acts of ejaculation are so short that the circulation has no time to regain its normal equilibrium. Sexual excess and masturbation are still more potent factors in the production of pathological hyperæmia when associated with erotic mentality, alcohol and other elements of high living, or the gouty and rheumatic diathesis. If the causes of hyperæmia be long continued, subacute or chronic inflammation will probably supervene.

The relation of sexual excitement to the production of morbid conditions of the prostate should receive the greatest consideration. It should be understood that physical continence may be associated, so to speak, with mental incontinence, with resulting prostatic hyperæmia which may give rise to both functional and organic changes in the affected part. As will be seen in a subsequent chapter, it is the author's conviction that prostatic hyperæmia from frequently repeated and prolonged sexual excitement is an important

factor in the etiology of prostatic hypertrophy. The importance of avoiding all sources of sexual excitation, both mental and physical, cannot be too strongly insisted upon in the management of all diseases affecting the prostate and neck of the bladder.

A greater or less degree of prostatic hyperæmia is probably an almost constant concomitant of urethral and bladder disease, whether acute or chronic, and is due in these cases not only to an inflammation of vesico-urethral mucous membrane *per se*, but also to the frequent acts of micturition necessitated by irritation of the vesical neck. The termination of the act of micturition is characterized by reflex spasm of the cut-off muscle which is greatly exaggerated in the presence of hyperæsthesia of the posterior urethra incidental to inflammation or reflex irritation of this structure. So vigorous is the spasmodic contraction of the muscles constituting the physiological cut-off that actual traumatism of the prostate results. There is a marked disturbance of the circulation and not only an active hyperæmia, but a lessened power of resistance of both glandular and muscular structure to sources of infection.

Irritative and inflammatory affections of the lower bowel produce reflex irritation of the vesical neck with associated hyperæmia of the prostate. The hyperæmia and spasm may be so severe that retention of urine results. This is observed after operations about this part and in inflamed hemorrhoids. Rectal tenesmus, as seen in certain cases of dysentery and acute proctitis, is apt to produce somewhat similar conditions affecting the prostate and vesical neck. In cases of chronic disease of the lower bowel, such as polypi, stricture, tumors, and particularly hemorrhoids, passive congestion of the prostate results from obstruction to the venous circulation. The author has observed well-marked enlargement of the prostate associated with stricture of the rectum and hemorrhoids, and has seen the prostatic disturbance completely disappear after an operation on the lower bowel. Constipation, excessive horseback riding, and the modern exercise of bicycle riding, are efficient causes of prostatic hyperæmia in some cases.

Hyperæmia of the prostate exists in all cases of strangury produced by drugs. Cantharides, turpentine, and, it is said, the various balsamic preparations may produce this condition. Prostatic hyperæmia rarely, if ever, goes on to acute inflammation idiopathically. Instrumental interference with associated trauma and sepsis, or a mixed infection from posterior urethritis, is usually necessary to precipitate acute inflammation. Obstructive affections of the urethra are likely to produce more or less marked prostatic hyperæmia. Urethral strictures of small calibre are usually associated with more

or less marked engorgement of the prostate. Large-calibred penile strictures may produce prostatic hyperæmia reflexly, even where there is no appreciable obstruction to the passage of urine. The slightest degree of coarctation in the bulbo-membranous region is quite likely, from the close association of the nervous and vascular supply of the affected part with that of the prostate, to produce circulatory disturbance in the latter structure.

Whether or not chronic hyperæmia of the prostate may be the foundation of hypertrophy of the organ in after-life has been the subject of much difference of opinion. The author inclines to the affirmative, as will hereafter appear.

Hyperæmia of the prostate may become chronic. Under such circumstances it is usually of a passive character, and is generally associated with constipation and ungratified sexual desire. Sexual excitement is the most important factor in its production, and it is especially likely to exist in masturbators. This form of chronic hyperæmia is characterized by the escape of prostatic fluid at various times, and is usually supposed by the patient to be spermatorrhœa, while to the profession at large most cases are classified as prostatorrhœa. The congestion of the affected organ brings about hypersecretion, and in all probability a relaxed condition of the mouths of the prostatic ducts. The condition might be classified as prostatic catarrh were it not for the quite general association of this term with true inflammation. Follicular prostatitis as described by most authors implies this result of hypersecretion, and appears to the present writer to be a misnomer.

The principal disturbances from this form of prostatic disease are of a psychical rather than physical character.

Symptoms.

One of the most characteristic symptoms is a sense of fulness in the perineum and a sensation of a voluptuous character as of impending orgasm. There is likely to be a sensation of fulness in the rectum with possibly erotic sensations and more or less tenderness during the evacuation of the bowel. An urgent desire to urinate is almost invariably excited by the act of defæcation. There may be considerable engorgement of the prostate without much, if any, increase in the frequency of micturition. If, however, the point of departure be direct or reflex irritation or inflammation of the posterior urethra, frequent and painful micturition is an inevitable result. Even in cases in which micturition is not increased in frequency, the patient will very likely complain of some pain and a

bruised sensation in the perineum following the act of micturition. If the hyperæmia be long continued, "prostatorrhœa" is likely to supervene as a consequence of hypersecretory activity of the prostatic glands. In some cases the floor of the prostatic urethra becomes so hypersensitive that seminal emissions are frequent. Rusty or bloody semen is occasionally observed, but as a rule this symptom is indicative of seminal vesiculitis.

Pain during the paroxysmal spasm incidental to seminal ejaculation is a quite frequent symptom. Many patients, however, will state that coitus is beneficial. In such cases it is very safe to conclude that the condition of the prostate is one of simple hyperæmia. But even here it is not unusual for the patient to experience only temporary relief from coitus. Often repeated indulgence results in aggravation of the symptoms. Rectal examination may elicit some fulness and tenderness of the prostate. This is not always present, as there may be quite a degree of passive hyperæmia without any particular increase in the size of the prostate. This symptom is quite apt to be unreliable, because of the variability of the size of the prostate as felt per rectum and the varying degrees of digital expertness in rectal examinations. Passive hyperæmia of the prostate associated with circulatory disturbance in the lower bowel, or dependent upon a gouty or rheumatic diathesis, is occasionally associated with hæmaturia. The author has observed a number of cases of hæmaturia with the expulsion of the characteristic fusiform clot found in prostatic hemorrhage, in which he was unable to determine any other cause than a condition of passive prostatic congestion, which attention to the assumed etiological factors very speedily relieved, measures to relieve portal congestion having been especially efficacious. This point is worthy of consideration in cases of hæmaturia of obscure origin.

A very frequent symptom of chronic hyperæmia of the prostate is a discharge of the characteristic secretion of the affected organ from the urethra. This is favored by sexual excitement, erotic ideas being sufficient in some cases to produce it. Under such circumstances it is associated with a greater or less amount of secretion from the urethral glands, the secretion of the latter escaping during the excitement, while the prostatic secretion afterward comes away with the escaping urine. It is most frequently observed during straining at stool, and sufficient secretion may escape with the outflowing urine to produce an appreciable deposit in this fluid when allowed to stand. Very often no discharge of the prostatic fluid is observed excepting at the termination of the act of micturition, when, according to the patient's story, the urine appears to be decidedly milky. These

patients are of all others the most likely to become the victims of the quack, and they constitute by far the larger proportion of cases of alleged spermatorrhœa. Associated with the local difficulty is more or less hypochondria, perhaps verging upon melancholia. The patient occupies himself very industriously in magnifying every symptom, real or imaginary, of which he may chance to be the victim. The unstable condition of the patient's mind is a sufficient explanation of the profound influence which quacks and quack literature are likely to have upon him. Associated with the so-called prostatorrhœa may be more or less vesical irritation, largely neurotic in character, and perhaps neuralgic pains in the urethra, perineum, groins, and thighs. The majority of patients complain of pain in the back as the most prominent symptom aside from the urethral discharge.

Whenever fluid escapes from the meatus during the intervals of micturition, excepting during the act of defæcation, some morbid condition of the anterior urethra is superadded to the prostatic hyperæmia. The prostatic fluid cannot escape unless the true sphincter vesicæ—*i.e.*, the membraneous urethra and its muscular investments—be physiologically relaxed, or the prostate be mechanically squeezed by the perineal muscles and the passage of hardened fæces.

The fluid which escapes during sexual excitement consists of the secretion from the urethral glands. The term prostatorrhœa has about the same significance, as far as its relation to the affected part is concerned, that gleet does to diseases of the urethra. It is a term which it might be well to dispense with altogether, excepting with the understanding that it is merely a symptom. In cases of simple chronic hyperæmia of the prostate, the resulting discharge of prostatic secretion does not contain inflammatory elements, being made up almost entirely of prostatic secretion, mucus, and some effete epithelial cells. There may be present, especially after sexual excitement, a certain number of seminal elements which have escaped from the over-distended vesiculæ seminales. The escape of semen into the prostatic urethra is favored by a relaxation or patulousness of the mouths of the ejaculatory ducts, and is often immediately induced by straining at stool. The seminal elements are few in number and their presence is by no means a necessary symptom. Rarely indeed, are they sufficiently abundant to warrant the use of the term spermatorrhœa. No matter how few in number they may be, however, they are hailed with delight by the spermatorrhœa-seeking quack, and undue importance is often attached to their presence even by honest practitioners.

Treatment.

The first principles of treatment of prostatic hyperæmia involve all of the rules of genito-urinary hygiene, a subject which cannot here be exhaustively discussed. Briefly, the urine should be rendered unirritating by the administration of bland fluids, of which distilled water or the various saline mineral waters may be taken as the type. Alkaline remedies may be administered where simpler measures are not sufficient to neutralize urinary acidity. The diet should be unstimulating, milk being the ideal form of aliment for reasons too thoroughly understood to require expatiation. All sources of sexual excitation, both mental and physical, should be removed. Exercise should be restricted and, if necessary, prohibited altogether. Athletic feats, bicycling, horseback riding, and climbing are particularly to be forbidden. Climbing exercises, as practised by young lads and some athletes, are especially injurious. The danger of the supervention of acute inflammation or of a chronic condition of disease should be impressed upon the patient. Instrumentation of the urethra is in a general way to be avoided in acute hyperæmia. There are numerous internal remedies which are serviceable in prostatic congestion. Mercurial and saline cathartics and laxatives are especially beneficial as tending to relieve hepatic congestion, and thus indirectly to remove obstruction to the pelvic circulation. Ergot and the fluid extract of gossypium are of undoubted value as directly tending to correct the circulatory disturbance. The element of sexual excitation is best combated by the administration of the bromides in combination with gelsemium. Monobromide of camphor, hyoscyamus, and some other anaphrodisiacs are likely to be of service. Suppositories of ice and enemata of cold water are often valuable. Cold sitz-baths constitute an excellent adjuvant. In prostatic hyperæmia dependent upon ano-rectal or vesical disease, the treatment should necessarily be directed to the relief of the primary condition.

In cases of chronic prostatic hyperæmia associated with so-called prostatorrhœa, special attention should be paid to the psychological disturbances present. It is rarely indeed that such cases come under the observation of the reputable practitioner before a number of quacks have been consulted. The patient is thoroughly imbued with the notion that he has spermatorrhœa with an allied train of serious nervous disturbances, and last, but not least, he believes himself to be impotent. Instruction in sexual physiology and hygiene is absolutely necessary for this class of patients. Particularly must they be impressed with the fact that they are not losing semen in the

urine, else all of our efforts will be set at naught by the morbid condition of the patient's mind. By far the larger proportion of cases will be found to be suffering from constipation. The relief of this condition in most instances causes the prostatorrhœa, which is the most prominent symptom in the mind of the patient, to disappear. Ergot and the bromides are exceedingly useful internal remedies. Hamamelis and hydrastis are likely to be serviceable from their known influence over unstriated muscular fibre and incidentally by controlling vascular supply. Tonics are very likely to be useful in this class of cases. Various preparations of strychnine, iron, and arsenic and the mineral acids are of service. The occasional passage of the cold steel sound constitutes a most valuable local measure of treatment. The effect of instrumentation is to a certain extent moral, but the resulting benefit is none the less marked. The physical effect is probably the restoration of local vascular tone and a relief of nervous irritability. Cold sitz-baths and injections of cold water into the rectum constitute a valuable adjuvant. Counter-irritation of the perineum is likely to be beneficial. The local application of astringents directly to the prostatic sinus may be alternated with the insertion of the steel sound. Nitrate of silver in mild solutions, tannic acid, and the muriate of hydrastine are all serviceable drugs. Soluble bougies containing astringents are sometimes of service. The local treatment in prostatic hyperæmia associated with so-called prostatorrhœa is very similar to that of chronic follicular prostatitis, in which escape of prostatic secretion is also a symptom.

Acute Prostatitis.

Acute prostatitis is one of the most serious and painful of the acute affections to which the genito-urinary system is subject. The condition which most often gives rise to it is so prevalent that the disease is quite frequently met with. Acute prostatitis with associated urinary retention was recognized many years ago by the celebrated French surgeon, Jean Louis Petit, as shown in his posthumous works ("Œuvres posthumes de Chirurgie," par Lesne, Paris, 1774). It is a noteworthy fact that the reputation of Petit as a careful clinical observer is borne out by his ideas of the etiology and pathology of acute prostatitis, which were in the main in accord with the more modern views upon the subject. He stated that, according to his observations, nearly all patients affected by acute prostatitis had suffered from a more or less recent attack of gonorrhœa, which in most instances had not been methodically treated.

In a general way, it may be asserted that while acute prostatitis may or may not be preceded by hyperæmia of greater or less duration, which acts as a predisposing factor, the disease is very rarely a primary affection excepting it be of traumatic or chemical origin, or the result of pyogenesis secondary to constitutional infection, such as exists in variola and parotiditis. As usually met with it is a complication, not a primary disease. The profound local and constitutional disturbance resulting in a large proportion of cases of acute inflammation of the prostate, and especially in those forms in which suppuration results, are entirely disproportionate to the size and physiological importance of the organ involved. The affected structure, however, is exceedingly sensitive from its abundant supply of general and special sensory nerve filaments, and assumes a position of great importance by virtue of its abundant sympathetic nerve supply and its consequent intimate relations with the various organs involved in the functions of organic life. In this respect it resembles rather strongly its colaborer in the generative function, the testis. Like the latter organ, it is surrounded by a tough resisting capsule and, in addition, by an environment of firm resisting structures. As a consequence of this anatomical arrangement the organ is very unyielding to the pressure of exuded inflammatory products, or of exaggerated blood supply. This, in connection with the exceedingly sensitive and abundant nerve filaments, is sufficient to explain the severe pain, nervous depression, and other constitutional disturbances incidental to inflammation of the organ. The same anatomical conditions of nervous and vascular supply, and the close proximity of the affected organ to the rectum, explain the disturbances referable to the latter viscus in the course of acute prostatitis.

Etiology.

The causes of acute prostatitis, as outlined by some authors, constitute a rather complex subject, presenting many elements of impracticality and sources of confusion. Practical clinical experience shows that while many predisposing elements necessarily enter into consideration, acute prostatitis is precipitated in the majority of instances by causes of rather a common character. Thus nearly all cases are found to be due to direct extension of acute inflammation of the urethra, usually of gonorrheal origin. Other factors are to be taken into consideration, it is true, in those cases in which suppuration results, because of the clinical fact that in by far the larger proportion of cases of acute prostatitis suppuration does not follow. The author bases this broad assertion upon the view that in the

larger proportion of cases of acute inflammation of the prostate the process is limited to the glandular structures of the organ, and partakes of the same characters as the original gonorrhœal infection with certain modifications due to anatomical and physiological peculiarities of the affected part. Mechanical interference with the prostate, incidental to the treatment of acute or chronic bladder difficulties or for the purpose of exploration, is responsible for most of the remaining cases. Even here we have gonorrhœal or other infection of the urethra as the principal etiological factor, the instrument used acting merely as a carrier of infection, or establishing a *locus minoris resistentiæ* by injuring the prostatic urethra. The experience of every practical surgeon has shown that in every case of urethral disease, acute or chronic, more particularly in the acute forms of inflammation, the patient is constantly liable to the development of an acute inflammation of the prostate.

In view of the careless, routine, and often over-vigorous treatment of gonorrhœa, to say nothing of the vicious self-imposed hygienic conditions of the patient, it is a matter of surprise that prostatic complications do not occur in every case of gonorrhœal infection. That patients with virulent urethritis of specific origin should escape prostatic complications, is to the mind of the author somewhat remarkable, when we consider the high degree of infectiousness of the various microbial organisms and their products characteristic of that typically mixed infection known as gonorrhœa. Acute prostatitis may be developed by very trifling causes during the course of a gonorrhœa. These causes may consist in ill-advised attempts to cure the disease, or in misconduct on the part of the patient.

The disease is especially liable to follow indiscretions or excitement of a sexual character. Alcoholic and dietetic excesses and over-exertion play a most important rôle in developing this complication in the course of a gonorrhœa.

As a preliminary to the discussion of the etiology of acute prostatitis in detail, a presentation of the various etiological factors as accepted by various authorities may be serviceable. The etiological table of Segond is one of the most elaborate schematic outlines of etiological possibilities that have thus far been presented in connection with acute prostatitis. In considering this table, the practitioner should understand that it will prove of little value unless the various causes outlined therein be assigned their true importance as etiological factors. This being understood, the table itself will enable us to reduce the etiology of acute prostatitis to a comparatively simple basis.

Segond's table is as follows:

Acute Prostatitis.

I. From indirect causes.	Exposure to cold (*Prostatites à frigore*). Metastasis, purulent infection from mumps, variola, etc.
II. From direct mechanical causes.	(*a*) Traumatic prostatitis, due to contusions from without inward, produced by falls, blows, horseback riding, etc. (*b*) Contusions from within outward, produced by forcible injections, or rough instrumentation. (*c*) Wounds from without inward, produced by pelvic fractures, falls on pointed objects, gun-shot wounds or surgical interference with the organ. (*d*) Wounds from within outward, produced by instrumentation with or without resulting false passages, or produced by the stylet escaping from the eye of the catheter during the introduction of that instrument. Any variety of wound of the urethra produced by surgical or accidental traumatism.
III. From direct irritation.	Cauterization with nitrate of silver, caustic or astringent injections. Cantharides internally, excessive indulgence in alcoholics, overdoses of the balsams. Vesical or prostatic calculi, or other foreign bodies in the prostatic urethra. The retained catheter or bougie. Horseback riding, over-exertion in walking or running, constipation, excessive purgation, sedentary habits, varicosity of the rectal veins, masturbation and sexual excess, nocturnal pollutions, prostatic hypertrophy.
IV. From propagation.	By continuity..... Gonorrhoea, cystitis, internal urethrotomy, or other operations on the urethra.
	By contiguity..... Hemorrhoids, rectal stricture or neoplasm, proctitis, and fistula in ano.

As a broad proposition, it is safe to assert that by far the majority of cases of acute prostatitis are due to infection in some form. This being accepted, it is obvious that many of the causes outlined in Segond's table are factors secondary and subordinate to infection. If we add to the cases produced by infection the relatively much smaller number of cases produced by mechanical and chemical violence, we have practically included all the causes of acute prostatitis. It is to be understood also that in many instances chemical and traumatic injuries of the prostate induce acute prostatitis solely by carrying infection or by opening up avenues for the absorption of infective material. It is of course a difficult matter to separate these cases from those in which the inflammation is immediately due to traumatic or chemical causes. Generally speaking, however, it is safe to assume that in the cases in which suppuration occurs, chemical or traumatic injury to the prostate, if it exists at all, acts as a factor subordinate to infection.

The following rather simple classification may give a somewhat clearer insight into the etiology of acute prostatitis than either the elaborate etiological table or the general remarks thus far presented:

Acute Prostatitis.

- **Predisposing causes.**
  - **General**
    - The gouty and rheumatic diatheses.
    - Alcoholic and dietetic excesses.
    - Exposure to cold.
  - **Local**
    - Highly acid urine.
    - Hyperæmia from whatever cause.
    - Acute or chronic urethritis.
    - Stricture.
    - Chronic prostatic disease.
    - Cystitis or other vesical diseases.
    - Vesical calculi.
    - Rectal and anal disease.
    - Portal obstruction.
    - Constipation or diarrhœa.
    - Over-exertion, and such forms of exercise as bicycling and horseback riding.
- **Exciting causes**
  - Gonorrhœa and its congeners—by direct extension, or indirectly by absorption of infectious materials—*i.e.*, germs or their products.
  - Traumatism—surgical or accidental, chemical or mechanical.
  - Sexual indulgence.
  - Chemical irritation.
  - Vesical or prostatic calculi.
  - Transportation of infectious material by deep injections or instrumentation.

Exposure to cold unassociated with a gouty or rheumatic diathesis is not, in the opinion of the author, a very efficient cause of acute prostatitis, unless some source of infection be present. That profound disturbance of the circulation of the prostate may result from chilling of the surface of the body, particularly when the lower extremities are exposed to cold and wet, is admitted. That this will result in acute prostatitis in cases in which some source of infection is not already present, cannot, however, be accepted in the light of our present knowledge of the germ origin of disease. Given, however, the existence of infection of the urethra, prostate, or bladder, the disturbance of the circulation incidental to exposure may develop a lessened degree of resistance to germ infection on the part of the prostate which may result in acute prostatitis with or without the occurrence of abscess. Cases are frequently met with in which patients presumably have had no infectious disease of the genito-urinary tract, but in whom a certain degree of irritation of the neck of the bladder results from exposure to cold. It will be found, however, that in such cases there usually exists a more or less marked

tendency to rheumatism or gout. Many of the cases of so-called prostatitis consist merely in an irritation of the mucous membrane of the prostatic urethra, due to the development of an excess of uric acid crystals in the urine incidental to chilling of the surface of the body. That such cases are frequently diagnosed as acute prostatitis, the author is fully aware. In the majority of such cases, however, not only is there an entire absence of true inflammation of the prostate, but there is no inflammation of the prostatic urethra itself, the condition being merely one of local irritation of a highly sensitive nervous structure resulting from the presence in the urine of irritating crystals of uric acid and possibly of oxalate of lime. The prolonged contact of the perineum with a cold and damp surface is said to be an efficient cause of acute prostatitis. While this may be a cause of secondary importance, in all probability it is not capable of inducing acute inflammation of the organ in question unless some source of infection exists. The gouty and rheumatic diatheses, either alone or associated with exposure to cold and wet, may develop prostatic irritation and possibly precipitate true acute prostatitis in cases in which infection already exists. The influence of gout and rheumatism is exerted not only in the direction of aberration of the quality and quantity of urinary solids and an alteration of urinary reaction, but also in the production of an intrinsic irritability of nervous and vascular structures, by virtue of which they react more promptly and markedly to sources of irritation. It is obvious that an individual who is exposed to psychical or physical causes of sexual excitement is especially predisposed to the development of acute prostatic inflammation in the presence of infectious genito-urinary disease. It is certain that if this particular predisposing cause could be entirely eliminated in the majority of cases of acute or chronic genito-urinary disease, the proportion of cases in which prostatitis develops as a complication would be very materially reduced. Acute or chronic disease of the urethra constitutes a constant menace to the prostate. Stricture of the urethra, which seems to have been entirely overlooked by Segond, is worthy of consideration in this regard. These conditions of acute or chronic inflammation may produce acute prostatitis from comparatively trifling exciting causes. It is obvious that chronic prostatic disease, especially those forms in which a focus of infection exists in the prostatic urethra or bladder, are likely to be complicated by acute prostatitis. Especially is this true if traumatic interference, in the form of violent or often-repeated catheterization, be added as an exciting cause. Acute prostatitis or para-prostatitis is a rather frequent complication of prostatic hypertrophy. What has been said of acute and chronic disease of the prostate applies equally to cystitis.

The infectious products of inflammation of the bladder may at any time, whether under the exciting influence of traumatism or through the medium of a secondary infection of the prostate and prostatic urethra, produce acute prostatitis.

Rectal and anal disease exert so profound an influence over the vascular and nervous supply of the prostate that their importance as etiological factors predisposing to acute inflammation of the organ is by no means surprising. Physical exertion, particularly that involved in walking, running, lifting, bicycling, and other forms of athletic exercises, in which more or less strain is brought to bear upon the perineum, tends to produce an irritable and hyperæmic condition of the prostate, in the presence of which any source of infection is apt to manifest itself in the form of acute inflammation of the organ. In by far the majority of cases of acute prostatitis there exists some urethral source of infection, either patent or obscure, as a direct exciting cause of the acute inflammation. True suppurative inflammation of the urethra is not, however, absolutely necessary in order that infection by germs or germ products may occur. Thus the infection may consist of the products of decomposing urine, or the secretions of urethral or prostatic catarrh, confined behind some obstruction of the urethra, such as is afforded by prostatic hypertrophy or stricture of the canal. The cause is likely to be a recent gonorrhœa of an acute virulent type, but the infective inflammation may be subacute or chronic. Simple urethritis, acute or chronic, presents a secretion teeming with germs and their products, which may at any time produce acute inflammation of the prostate. It must be remembered in this connection that it is probably the mixed character of the infection which is in all cases responsible for the cases in which suppuration of the prostate or peri-prostatic tissues occurs.

Laying aside the cases of acute follicular prostatitis—*i.e.*, posterior urethritis occurring in the course of acute or chronic gonorrhœa, the pus microbe and its products are responsible for prostatic complications. It is safe to assert that in most of the cases of acute prostatitis, an area of suppuration or bacterial infection exists in the deep urethra. The cause may consist of a suppurative or chronic infective inflammation of the bulbous or bulbo-membranous region. These conditions existing, the slightest traumatism or the occurrence of active hyperæmia may at any time produce an acute and violent inflammation of the prostate. One of the most frequent causes is the mechanical disturbance of the prostate incidental to sexual intercourse. During the occurrence of the venereal orgasm the muscular tissues of the perineum, and incidentally of the prostate, act very

much upon the principle of the bulb of the ordinary Davidson syringe. The spasmodic contraction incidental to the orgasm alternates with relaxation, during which the deep perineal muscles and the prostate probably exert what may be termed an aspirating effect upon the urethra. The superfluous semen is drawn back into the deep urethra preparatory to the occurrence of the spasmodic muscular contraction by means of which the last few drops of semen are to be expelled into the urethra and thence into the vagina. During the aspiration of the semen into the deep urethra, any infectious materials which may exist in the anterior portion of the canal are forcibly drawn into the deeper parts, where they produce acute infection. This, while primarily an acute follicular prostatitis, may be followed at any time, and perhaps within a very short period, by acute diffuse inflammation and possibly abscess of the prostate. It is a matter of common observation that patients presenting themselves with acute prostatitis in the course of gonorrhœa, confess to sexual indulgence or the occurrence of a nocturnal emission as the immediate exciting cause. In the opinion of the author, the foregoing constitutes a logical explanation of its occurrence.

In quite a proportion of cases, infection of the prostate in the course of gonorrhœa or urethritis is a result of deep injections or the passage of instruments. While it is true that in some instances the exciting cause would seem to be a high degree of chemical irritation produced by the injection, it is probable that in by far the larger proportion of instances in which the prostatitis can fairly be attributed to the use of injections, the fluid so used is only indirectly responsible for the occurrence of the prostatitis, inasmuch as it serves merely as a carrier of germ infection. It is probable that the injection of pure water would be equally, if not more, effective in this respect. It has been the experience of the author that the frequency of prostatic complications is directly proportionate to the vigor with which the treatment of acute gonorrhœa is pursued. Some of the worst cases coming under observation are due to the passage of instruments for the relief of retention, or for the treatment of the urethritis. Soluble bougies and deep urethral irrigation, used during the acute stages of urethral inflammation, have been responsible for a large number of cases. The soluble bougie or the tube used in deep irrigation acts as the carrier of germ infection which the injected solution is too weak to destroy. Then, too, we have the abrading effect of the instrument or soluble bougie upon already degenerated and readily removable epithelium. This opens up avenues of infection which otherwise might possibly never occur.

The excessive use of terebinthinate and balsamic preparations has

been said to cause prostatitis. It is possible that in very large toxic doses these drugs, in combination with an already existing infection of the deep urethra, may be operative in producing acute inflammation, but under no other circumstances. Cantharides in poisonous doses produces inflammation of the prostate in common with all the other structures composing the genito-urinary tract.

In concluding the subject of the etiology of acute prostatitis, the author desires to emphasize the paramount importance of infection as a factor in the etiology of the disease, and to insist on the subordinate character of by far the larger proportion of the causes enumerated not only in the table of Segond, but in the much simpler etiological classification already suggested. A further practical point of great importance is the clinical fact that, given an acute or chronic source of infection, and especially the former very slight interference with the urethra and bladder may serve to precipitate an acute inflammation and perhaps abscess of the prostate.

Varieties.

Acute prostatitis presents itself in several forms according to the method of causation and the structures to which the acute inflammation is mainly localized. Without the slightest disposition to be dogmatic in the matter of classification, the author inclines to the view that from a clinical standpoint the following forms of acute prostatitis are capable of a clinical differentiation which is of vital importance in the study and management of such cases.

A. *Follicular or parenchymatous prostatitis*, having its point of departure in a posterior urethritis due to extension or transference of infection to the deep urethra.

B. *Diffuse prostatitis*, usually presenting itself as a consequence of extension of the acute follicular form. It may, however, occur as a primary condition. The presence and degree of interstitial inflammation in the diffuse form of the disease depend upon the method of causation, *i.e.*, whether it is due to traumatism, to extension, or to lymphatic infection. This may be associated with localized or disseminated pyogenic infection.

C. *Prostatitis with Circumscribed Suppuration.*—Acute suppurative prostatitis, due to extension of urethral inflammation, infection from local absorption, or infection through the lymphatics or the blood-vessels.

D. *Prostatitis with Disseminated Foci of Suppuration (Miliary Abscesses).*—In all forms of prostatitis associated with suppuration more or less diffuse interstitial inflammation is invariably present.

E. *Para-prostatitis.*—This is usually but not necessarily followed by abscess, and is associated with one or the other of the foregoing forms.

The basis for classification A is due to the belief of the author that the most important ultimate anatomical element of the prostate is the secreting glandular tissue. According to this view the glands, ducts, and follicles of the organ constitute the true parenchyma. The acute follicular or parenchymatous form of the disease embraces most of the cases of so-called acute posterior urethritis, and varies in severity from an involvement of the follicles alone to that of all the secreting structures of the organ. Indeed, it is the opinion of the author that the acute inflammation of the prostatic urethra in these cases is relatively unimportant in the pathological *ensemble*, save as the point of departure of the prostatic inflammation. Most of these cases should be classified as acute follicular or parenchymatous prostatitis. In practically all, if not actually in all, of the cases of so-called acute posterior urethritis from gonorrhœa or other source of mixed infection, the inflammation of the mucous membrane of the deep urethra is but a small part of the morbid condition resulting from such infection. The author cannot conceive of an acute inflammation of infectious origin which limits itself to the mucous membrane of the posterior urethra. A few subacute and chronic cases possibly are met with in which the bulbo-membranous region is involved without extension or transference to the prostatic urethra. It is the belief of the writer, however, that in all cases, whether acute or chronic, in which the prostatic portion of the urethra is involved, the glandular elements of the prostate become affected sooner or later. In acute cases of inflammation extending beyond the bulbo-membranous junction, the author does not believe that the glandular elements of the prostate can possibly escape involvement. It is certainly open to argument whether or not the consideration of so-called posterior urethritis as an acute or chronic follicular inflammation of the prostate, rather than a disease of the urethra *per se*, might not be of great practical clinical importance, as explaining the extreme obstinacy of the disease and the impossibility of curing it completely by applications to the small and unimportant infected area presented by the mucous membrane lining the prostatic urethra. Looking at posterior urethritis from this standpoint, the question might arise whether deep injections of astringents may not defeat the very object which the practitioner strives to attain in such cases, by impeding drainage from the glandular elements and ducts of the prostate constituting the principal seat of the infectious inflammation. Associated with these cases there is usually more or less involvement of the inter-

stitial tissue surrounding the ducts and glands of the organ, the resulting mechanical conditions depending entirely upon the degree of involvement.

From a clinical standpoint, there would seem to be a broad line of distinction between the acute cases of follicular inflammation from extension of infection from the prostatic urethra and cases in which, as a result of lymphatic absorption or of infection of an abraded surface produced by traumatism, prostatic or peri-prostatic abscess occurs. On the one hand, we have a case presenting primarily all of those symptoms characteristic of irritation and inflammation of the true vesical neck, *i.e.*, the prostatic urethra; while, on the other hand, we have a much less degree of vesical irritability with the development of more or less sudden obstruction to the outflow of urine. In acute follicular inflammation retention of urine rarely results, excepting in cases in which there is a high degree of interstitial inflammation. So frequent, however, is the association of retention with the occurrence of prostatic abscess that the latter is to be strongly suspected in cases of acute prostatitis in which retention of urine is a prominent factor.

In the diffuse form of the disease there is usually, as a result of extension of the infectious process from the prostatic urethra, a very severe degree of glandular inflammation. Associated with this is a well-pronounced involvement of the interstitial tissue. In these cases, on account of the anatomical conditions already outlined, the local pain and the constitutional symptoms are much more marked than in the acute follicular form. The diffuse form may be the result of lymphatic absorption, in which pain, rectal tenesmus, and urinary obstruction may develop without any preceding vesical irritability. Abscesses may or may not occur in the diffuse variety of acute prostatitis. When they do occur they may be the result of a general infection of the organ, or an occluded duct or follicle may constitute the primary focus of infection which subsequently ruptures and infects the surrounding tissues of the prostate.

Acute suppurative prostatitis, as already outlined in the preceding classification, may occur in one of three forms: 1. Circumscribed abscess, single or multiple. These abscesses may involve any particular portion of the tissue of the prostate; may be of considerable size, and one or more may coalesce, forming a large abscess cavity. 2. Disseminated suppuration in the form of miliary abscesses. 3. Abscess of the peri-prostatic tissue with or without suppuration in the prostate proper. While usually due to local sources of infection, any of these forms of abscess may occur as a result of general pyogenic infection, and, as shown in the table of Segond, may result

from such infectious diseases as variola and mumps. Some cases of abscess are primarily due to extension of suppurative inflammation, while others are due to lymphatic absorption and infection of the tissues of the prostate. In some instances, in all probability, one or more of the numerous ducts of the prostate become occluded by the inflammatory swelling incidental to virulent inflammation, with the consequent retention of infectious pus in the form of a small abscess cavity, the walls of which are composed of the walls of the duct or the follicle involved. Such circumscribed retention abscesses constitute foci of infection of the surrounding tissues, and when they form at the periphery of the organ they may rupture into the para-prostatic tissue with the resulting formation of an abscess in this situation.

Disseminated foci of suppuration in the prostate constitute the variety which is most likely to occur from constitutional infection. The rupture of a small abscess, however small, into the peri-prostatic tissue will almost inevitably result in an abscess in this situation.

It is unnecessary to expatiate upon para-prostatitis, inasmuch as the most important points have already been set forth. It is sufficient to say that it most usually occurs as a secondary factor in one or the other of the foregoing forms of acute inflammation. Suppuration usually occurs, and in some cases its extent may be rather startling, the pus burrowing extensively about the rectum. Retention of urine is a usual concomitant of marked cases.

Prostatic Abscess.—The subject of acute prostatic abscess hardly requires consideration independently of acute prostatitis. There are several points, however, in connection with suppuration of the prostate that merit special attention. Abscess of the prostate in the course of hypertrophy of the organ is much more frequent than is ordinarily supposed. It may occur spontaneously as a result of infection, although this is extremely rare. Most often it occurs as the direct result of traumatism inflicted during the treatment of the disease, or during the passage of the catheter for the relief of retention dependent upon it. It is the opinion of the author that in quite a proportion of cases in which a fatal result follows retention of urine from hypertrophied prostate necessitating prolonged and frequent instrumentation for its relief, the immediate cause of death is general septic or pus infection incidental to suppuration of the prostate induced by the surgical interference. Several cases have come under the observation of the author in which the patient developed the constitutional manifestations of sepsis and finally sank into a typhoid condition and died, as a consequence of extensive prostatic

and peri-prostatic abscess, which was directly traceable to bungling and injudicious attempts at catheterization. In some of these cases the resulting abscess is of a subacute or chronic character and is of prolonged duration. Rupture may finally occur into the urethra, rarely externally, in which event sudden relief of the obstructive symptoms may result. It is a noteworthy fact that some cases of prostatic abscess occurring in the course of enlarged prostate are ultimately followed by great benefit to the primary condition. The destruction of the prostatic tissue incidental to the abscess formation is followed by cicatricial contraction and a marked diminution of the mechanical obstruction incidental to the enlargement of the organ. In some instances, however, the abscess cavity not only does not become obliterated, but remains as a suppurating pocket, opening more or less freely into the lumen of the urethra and giving rise to successive re-infections of the posterior urethra and bladder, or even infection of the anterior portion of the canal. This is true of all forms of prostatic abscess. In abscess occurring in prostatic hypertrophy it is interesting to note the marked diminution in the size of that portion of the prostate which happens to be the seat of suppuration. In a case which the writer has recently seen an abscess in the right lobe of the prostate, in a gentleman of middle age suffering with prostatic hypertrophy, has produced so much shrinkage of the affected structure that it is hardly, if at all, larger than the normal, while the opposite side is still markedly hypertrophied and indurated.

The occasional occurrence of prostatic abscess in *prostatiques* constitutes a very practical point in the study of prostatic hypertrophy. It is by no means unusual for the first severe symptoms of prostatic obstruction in old men to occur coincidentally with the formation of the prostatic abscess. Inasmuch as after evacuation of the abscess the symptoms practically disappear, an erroneous diagnosis is quite easily made, the case being considered as *ab initio* one of prostatic suppuration.

That a fatal result may follow prostatic abscess not only in old but in young subjects must be borne in mind. A case recently came under my observation in which a young man, thirty-five years of age, was permitted to die of what was supposed to be typhoid fever, but which, as the autopsy showed, was sepsis due to a large prostatic abscess. It is well in all cases of serious prostatic disease, to keep a close watch for the constitutional symptoms of suppuration. Free incision and drainage would in all probability have saved the life of the patient to whom allusion has been made. In all cases of acute prostatic inflammation it is the duty of the surgeon to be on the alert for symptoms of suppuration. Oftentimes, however, a diag-

nosis can only be made after the discharge of the contained pus into the urethra, bladder, or rectum.

Healing of prostatic abscess after such evacuation is often quite prompt, but in many cases the admixture of urine with the contents of the abscess causes serious trouble by subsequent decomposition and septic absorption.

Ano-rectal fistula may result in cases in which the abscess opens or is evacuated by the knife through the rectum. Urinary fistula communicating with the rectum or with the ano-rectal fistula may also develop. Urinary fistula following evacuation of the pus through the perineum is not infrequent.

Morbid Anatomy.

Comparatively little is known of the early stages of acute prostatic inflammation, especially of the follicular or parenchymatous form. The condition is not a fatal one and the opportunities for observation are consequently not numerous. As far as determined, however, the process appears to be at first limited chiefly to the mucous membrane, the follicles, and the glands immediately tributary to the prostatic urethra; hence a description of the morbid anatomy of acute follicular prostatitis is also that of acute posterior urethritis. In the follicular form there is always a varying degree of involvement of the interstitial tissue, largely dependent upon the duration of the disease. It is the author's opinion that the infectious inflammation never limits itself to the prostatic urethra alone; if the inflammation does not extend below the membranous urethra, it may possibly become limited if it be not too acute in character. In acute bulbo-membranous inflammation, however, the prostatic urethra is almost inevitably involved sooner or later. The mucous membrane of the prostate is reddened and thickened, as is true of the mucous membranes in all situations under the influence of inflammation. There is almost invariably some thickening of the tissues surrounding the lymphatics and blood-vessels.

Ulceration does not occur, and resulting stricture is so exceedingly rare that it is hardly to be taken into consideration. The mouths of the prostatic and ejaculatory ducts are involved in the inflammation, thus serving to explain the facility with which the inflammation extends to the glandular tissues of the organ. In acute parenchymatous or follicular prostatitis the organ is swollen according to the degree of circulatory disturbance and peri-glandular swelling.

If the process extends to the inter-glandular, muscular, and peri-prostatic tissues we have the diffuse form of inflammation as accepted

by the writer; corresponding to the parenchymatous form described by Thompson. The organ is swollen in some cases to three or four times its natural size. The veins of the prostatic plexus are distended by dark blood. The arterial vascular supply is also engorged. The mucous membrane of the prostate is of a darker red than usual. Pressure causes the exudation of a cloudy, reddish fluid containing blood from the engorged capillaries and venules, inflammatory lymph, and fluid from the prostatic glands, with a small quantity of pus. Brissaud and Segond give a very clear description of the pathological anatomy of acute diffuse prostatitis, as observed in a man who died from a complicating pleuro-pneumonia. The glandular tubes were the seat of inflammation of a degree of intensity which was variable at different points. The internal wall of the ducts at points where the inflammation was most intense appeared to be blended with the muscular tissue by areas of inflammatory exudate. The inequality of the inflammatory process was especially noticeable. In different places, notably at the periphery of the organ, marked pathological changes in some of the glandular tissues coexisted with a perfectly healthy condition of neighboring glands and ducts. The epithelium lining the glandular culs-de-sac and ducts was replaced by an agglomeration of new tissue elements, often filling the ampullæ of the glands completely. In some instances the degenerative changes had obliterated the normal glandular outlines.

Suppuration presents itself under several forms. In the follicular form the suppuration is similar to that which occurs in gonorrhœa or urethritis, the pathological condition from which the process in the prostate was originally derived. Circumscribed abscess may form in the follicular form of acute prostatitis. One or more glands become infected, and incidentally their ducts are involved. Occlusion of the lumen of the latter may occur, as a consequence of which a suppurating cyst-like accumulation of pus results. One or more of these purulent accumulations may rupture and contaminate the remainder of the gland. Such abscesses are often responsible for recurrent infection. Miliary abscesses may result from acute suppuration. They are single or multiple and more or less disseminated. Large abscesses may be found in some cases. Abscess may occur in the cellular tissue surrounding the prostate—peri-prostatic abscess. Some prostatic abscesses are very large. Guyon exhibited a specimen in which the urethra was completely dissected out of the prostate and was entirely surrounded by pus. Abscess cavities are generally multilocular and trabeculated. These abscesses may open into the urethra by one or numerous openings.

Lallemand many years ago called attention to the fact that in

acute prostatitis the ejaculatory ducts may be dilated and thickened from involvement of the mucous membrane. They may be ulcerated or their lumen diminished, or in extreme cases even occluded. The seminal vesicles may be thickened, dilated, and contain reddish or puro-sanguinolent fluid. Regarding the accuracy of Lallemand's observations, a certain element of doubt is warrantable, because a large proportion of his patients were subjected to treatment by the *porte caustique*, which in itself was not only likely to set up acute prostatitis, but was very likely to be followed by occlusion of the ejaculatory ducts.

In some cases of suppuration the entire glandulo-muscular structure of the prostate is destroyed, as in the case outlined by Guyon. A case of this kind came under the observation of the author. The prostate was practically replaced by a suppurating cavity with quite thick walls, representing apparently the capsule of the prostate in conjunction with inflammatory new growth. The specimen was so damaged in removal, however, that it was impossible to obtain a clear idea of the relation of the urethra to the abscess.

Symptoms.

In the follicular form of acute prostatitis the symptoms are mainly subjective. Frequent and painful urination, pain being especially marked at the termination of the act, and in some cases the escape of a certain amount of blood with the last few drops of urine constitute the principal local symptoms. A feeling of distress in the perineum with pain radiating along the urethra into the spermatic cords or down the inner aspect of the thighs, is frequently experienced. In some cases there is more or less pain and tenesmus referable to the rectum. The stools are likely to be somewhat painful. There may be considerable constitutional disturbance, but as a rule this is very slight, if present at all, excepting where there is a greater or less degree of diffuse inflammation. In the diffuse form of inflammation and in the varieties in which pus formation occurs, there is more or less obstruction to the flow of urine. Complete retention may come on and persist until such time as the abscess evacuates itself or has been opened, when speedy relief of the symptoms occurs. When pathogenic infection of the prostate occurs independently of preceding follicular inflammation, there may be comparatively little irritation about the vesical neck, the symptoms of urinary obstruction preponderating. This is especially apt to be the case in those acute forms of abscess which come on in the course of prostatic hypertrophy. In the diffuse and suppurative forms of prostatitis, the pain

and constitutional symptoms are especially marked. Profound depression is likely to be present, and in *prostatiques* especially the patient may sink into a typhoid state and die with all of the symptoms of constitutional pyogenic infection. True pyæmia may result as a consequence of a localized suppuration. The formation of pus is likely to be heralded by a distinct chill. In some cases a succession of chills may occur. In some cases of acute prostatitis the disease develops very suddenly. In some instances a few hours, or possibly several days, may elapse before the symptoms become prominent. During this period the patient experiences premonitory sensations of weight and fulness in the perineum, with frequent micturition and a certain degree of depression incidental to the irritation of the vesical neck. In cases in which abscess forms severe throbbing pain is likely to come on. This may be of a lancinating rather than of a throbbing character, radiating, as already stated, into the urethra, groins, and thighs. The slightest exercise tends to aggravate the symptoms. The patient very often finds quite early in the course of the disease that slight perineal pressure gives rise to considerable pain and tenderness, and possibly vesical irritability.

According to Thompson, cystitis is likely to coexist with acute prostatitis, but in the opinion of the author this is quite rare, all of the symptoms being explicable by the involvement of the prostatic urethra. In cases having their point of departure in follicular inflammation, the urine contains muco-pus derived from two sources: *First*, that which is directly washed out of the prostatic urethra by the outflowing urine; *Second*, that which has taken the direction of least resistance and escaped back into the bladder during the intervals of micturition. The first and last portions of the urine in cases of follicular inflammation are likely to contain considerable muco-pus, the mid-stream of urine being comparatively clear. In cases in which there is no follicular inflammation, the condition being primarily one of diffuse inflammation, or of localized inflammation incidental to infection and followed by suppuration, the urine contains nothing characteristic until such time as the abscess ruptures into the urethra or bladder. In these cases the patient experiences a sudden feeling of relief in the perineum and ano-rectal region, the urine flows with perhaps its usual freedom, or at least much more easily than before the rupture of the abscess, and pus suddenly appears in the urine. It does not escape from the urethra during the intervals of micturition unless secondary infection of the anterior urethral mucous membrane occurs, or unless the point of rupture is located anterior to the bulbo-membranous junction.

The objective symptoms of acute prostatitis vary with the degree

of diffuse inflammation. Where the pathological process is largely of a follicular character, as in a certain proportion of cases of so-called posterior urethritis, local examination elicits very little save more or less tenderness on deep perineal pressure and on manipulation of the membranous and prostatic portions of the urethra per rectum. Deep pressure behind the pubes may elicit a certain degree of tenderness referable to the vesical neck. In the more severe types of diffuse and circumscribed suppurative inflammation more or less heat, swelling, tension, and tenderness of the perineum are noticeable. The prostate presents itself as a hot, tender tumor projecting into the rectum antero-posteriorly. The degree of enlargement varies with the extent of interstitial inflammation, and may be so marked that the finger cannot be introduced into the rectum without considerable difficulty and the production of very severe pain. When suppuration has occurred a boggy, œdematous, uniform, or circumscribed bulging of the prostate and peri-prostatic tissues into the rectum is noticeable.

Diagnosis.

Although the main diagnostic points in acute prostatitis are outlined in the foregoing symptomatology, a diagnostic *résumé* and consideration of certain special points in the differential diagnosis would seem necessary. The patient, generally the subject of acute or chronic urethritis, complains for several days of heaviness and pain in the perineum which he is quite likely to attribute to fatigue or over-exertion, or possibly, if he be one of the exceptionally honest patients whom we sometimes meet, to sexual stimulation or indulgence. In some cases the patient complains for several days of loss of appetite, possibly slight chilliness and well-marked *malaise*. Considerable mental depression may exist for some time before definite symptoms referable to the perineum occur. Vesical and anal tenesmus with dysuria, and in the majority of cases painful and difficult defæcation, soon develop. In other instances, the first indications of impending prostatic inflammation consist in symptoms of vesical irritation. In still another class of cases, the first and most prominent symptom consists not in vesical irritability, but in urinary obstruction, which grows more and more prominent and is apt to lead to complete retention. It is obvious that the symptoms are governed largely by the amount of inflammation of the prostatic urethra.

In cases in which inflammation of the posterior urethra is not the point of departure, as is true in many cases of suppurative inflammation, there may be little or no vesical irritation throughout the course of the case. Digital exploration of the rectum and perineum shows

perineal fulness and tenderness and a degree of bulging of the prostate into the rectum, due to enlargement of the organ, proportionate to the severity of the inflammation and the degree to which the interstitial and peri-prostatic tissues are involved.

Cowperitis may be mistaken for inflammation of the prostate. Palpation of the perineum, however, shows a lateral swelling and, if examined early, a distinctly circumscribed spherical tumor. The prostate on rectal examination is found to be either normal or only moderately enlarged. The urinary symptoms may be *nil*. The possibility of follicular prostatitis, without any great degree of enlargement of the prostate, existing as a complication of Cowperitis, or *vice versa*, should be taken into consideration.

Cases of acute inflammation of the prostate complicated by retention may require differentiation from stricture, especially that variety of the latter in which retention comes on suddenly from hyperæmia and spasm. The history of the case, digital exploration of the rectum, and the location of the obstruction generally serve for differentiation. It must be remembered, however, that stricture of the urethra is quite likely to be complicated by prostatic inflammation. Many cases of genito-urinary disease of an acute character are likely to present features which are, to say the least, decidedly mixed. Enlargement of the prostate, as a cause of retention, may usually be differentiated from acute prostatitis, by the age and history of the patient and the peculiar feel imparted to the finger in digital exploration of the rectum. The tenderness elicited by the latter method of examination may be very slight in prostatic hypertrophy. The possibility of acute prostatitis with suppuration or the formation of a chronic abscess as a complication of prostatic hypertrophy is to be borne in mind.

Acute cystitis may be mistaken for inflammation of the prostate. It is probable that by far the majority of cases of so-called acute gonorrhœal cystitis are really instances of acute follicular prostatitis. The vesical mucosa proper is rarely involved in gonorrhœal inflammation; indeed, it is claimed by excellent authorities that the vesical mucosa is immune to the gonococcus. Be this as it may, gonorrhœa is a mixed infection and the vesical mucosa may become infected by germs other than the gonococcus. It is not, however, particularly susceptible to simple pus infection.

When abscess of the prostate is definitely formed, the diagnosis is generally easy unless the collection of pus be quite small. Especially is the diagnosis easy when the abscess points toward the rectum. In many cases, however, the diagnosis is not only difficult, but the abscess is not detected until the pus has escaped by the urethra.

The author has observed a number of cases in which, although prostatic abscess was strongly suspected, the symptoms were of rather moderate intensity, no incision was made, and the diagnosis was only cleared up by the sudden escape of a greater or less quantity of pus from the urethra.

Zeissl calls attention to the possibility of confusion of prostatic with ischio-rectal abscess. In the latter, however, there are no especial symptoms referable to the bladder as a rule, and the unilateral position of the tumor with its distinct point of departure in the ischio-rectal fossa serves to clear up the diagnosis. In some instances ischio-rectal abscess is associated with more or less reflex irritation of the vesical neck. This may prove a source of confusion. The author has observed one case in which ischio-rectal abscess occurred coincidentally with acute follicular prostatitis. The possibility of the coexistence of the two conditions is to be borne in mind. In prostatitic phlegmon, and in all forms of well-marked prostatic inflammation, especially where suppuration occurs, the gravity of the constitutional symptoms and the profound nervous depression which exists are valuable points for consideration in the differential diagnosis.

Prognosis.

The prognosis of acute prostatitis in otherwise healthy subjects is quite favorable as regards the immediate recovery of the patient, whether suppuration occurs or not. As already indicated, some cases of suppuration prove fatal, this being especially true of the phlegmonous form which occurs sometimes in young subjects, but more often in *prostatiques* in whom general debility is more marked on the average than in younger men. The local symptoms are, however, likely to be improved in this class of cases after the evacuation of the abscess..

According to Segond the prognosis of generalized prostatic phlegmon is rather grave. In 114 cases collected by this authority, there were 34 deaths, ten cases in which permanent fistula followed, and 70 recoveries. Segond's statistics are not a fair criterion of the gravity of prostatic abscess taken as a whole. In many cases, even of prostatic phlegmon, an incorrect diagnosis is made, yet the patient eventually recovers after spontaneous evacuation of the pus. In the milder cases of prostatic abscess pus very frequently discharges into the urethra and apparent cure results, the true condition of affairs being unrecognized. It is the opinion of the author that many cases in which subsidence of the prostatic symptoms is coincidental with a sudden and marked recurrence of the urethral discharge, come under this head.

In both young and old subjects with prostatic abscess, persistent pyuria with exacerbations of cystitis and urethritis may supervene. The abscess, after evacuation into the urinary tract, instead of closing down and becoming obliterated, remains as a suppurating sac with one or more openings into the urinary canal. Decomposing urine and products of suppurative inflammation may perpetuate this condition of affairs indefinitely. In most cases in which abscess forms without marked follicular inflammation, the patient recovers completely. In the follicular form of the disease, however, and in those diffuse and suppurative forms in which follicular inflammation is the primary condition, the case is apt to become very stubborn. In the opinion of the author, no patient who had ever suffered from acute follicular prostatitis ever recovers completely. The proportion of patients who have chronic inflammation of the prostate, as a consequence of acute follicular prostatitis of gonorrhœal origin, is much greater than is ordinarily believed. Cases taken at random and studied upon the post-mortem table in our large cities will substantiate the accuracy of this assertion. In a careful study of nearly two hundred prostates, taken in this way, the writer found by far the larger proportion of cases to present evidences of more or less recent inflammation, in which, in all probability, the primary condition had been one of acute follicular prostatic inflammation. Practical observation should convince any thinking man that a prostate, the glandular tissue of which is once infected, is likely to be always more or less diseased.

Treatment.

The treatment of acute prostatitis should be very active. A brisk mercurial purge should be ordered at once, and be followed by a full dose of some saline in the course of three or four hours. Ten to fifteen grains of calomel followed by half an ounce of epsom salts is as good as it is old-fashioned, and will unload the portal circulation, as well as produce general depletion. An excellent way to use the mercurial and saline treatment is to put the patient on small doses of calomel, giving one-fifth of a grain in tablet triturate form every three hours until four or five doses have been taken. Coincidentally with the administration of the calomel, four-ounce doses of a saturated solution of sulphate of magnesia, containing glycerin in the proportion of about 1–3, should be given by enema. This may be repeated till the patient has had a number of watery evacuations. This is the ideal method of producing pelvic depletion, and is quite as valuable in prostatic disease as in pelvic and abdominal inflammation in the female. Having fulfilled this indication, there are several special

measures which are essential. The febrile symptoms call for aconite or veratrum viride, remedies which are far more reliable than antimony, as recommended by Thompson. Ergot and the fluid extract of hamamelis are probably beneficial. In my hands, at least, they have seemed to be efficacious. They are certainly philosophical remedies from a theoretical standpoint. These remedies may advantageously be combined with gelsemium and the bromide of potassium; anaphrodisiac remedies having an especially sedative effect upon the inflamed organ. Hypodermic injections of pilocarpine have proved serviceable in several of my own cases, this remedy being a powerful derivative.

After the bowels have been evacuated as already suggested, opium is the remedy upon which the most reliance is to be placed. As in all inflammations, opium is directly antagonistic to inflammation of the prostate. It relieves pain and strangury, lessens the frequency of micturition, and counteracts nervous depression. Opium and other anodynes act best in acute prostatitis when given by suppository. If the rectum be particularly irritable, the anodyne may be administered in the form of a thin ointment to be injected into the rectum. Iodoform may be combined with morphine and belladonna or hyoscyamus, and administered in the form of a suppository. Care should be taken to avoid large doses of anodynes per rectum, as most patients are much more susceptible to their toxic influence when given in this manner than is usually supposed. If the administration of anodynes *per os* be considered preferable to rectal medication, codeine will be found to be quite as reliable and much less disagreeble than the other preparations of opium.

The diet should be restricted to milk or other unstimulating fluid aliment, and the patient should lie quietly upon his back with the hips slightly elevated. Above all things, the patient should be impressed with the absolute necessity of perfect rest for some weeks, for in no disease is movement more likely to aggravate the morbid condition than in prostatitis. In many cases in which acute prostatitis assumes a subacute or chronic form and persists indefinitely, movement, sexual excitement, alcoholic and dietetic indulgence, one or all, are likely to be in great measure responsible. Too much stress cannot be put upon the necessity of perseverance in the rules of genito-urinary hygiene.

Local depletion should be resorted to early in the case and repeated from time to time as circumstances may require. This is best accomplished by means of leeches, cups being rather unhandy of application. Five to eight leeches should be applied to the perineum and about the anus, and the bleeding encouraged by warm

fomentations. The rationale of this treatment is obvious, if the intimate association of the prostatic and inferior hemorrhoidal plexuses be taken into consideration. After the hemorrhage has ceased, hot poultices or fomentations may be applied to the perineum. So great is the relief to be obtained by judicious leeching of the anoperineal region in acute inflammation of the prostate, that the sanguinary enthusiasm of our medical forefathers is hardly to be wondered at. It is perhaps unfortunate that this old-fashioned method of treatment is not more frequently adopted, not only in acute prostatitis but in other diseases in which local depletion is a desideratum.

Ice has been advocated, some surgeons even advising that suppositories of ice be inserted into the rectum. Hot water containing laudanum is often serviceable as an enema. Simple hot enemata, several quarts of water being used at each sitting, may be given several times daily with great advantage.

Interference with the urethra should be avoided, the usual treatment for gonorrhœa—if the disease exists—being suspended during the course of the prostatic inflammation. The use of injections may determine the formation of an abscess in an otherwise slight prostatitis.

Hot sitz-baths, twice or thrice daily, are of marked benefit in prostatitis; in order to be beneficial, however, they must be very hot and continued for at least an hour. Should retention occur and opium and the hot sitz-baths fail to relieve, then, and then only, is catheterism permissible. A small soft catheter should be carefully introduced and the urine drawn off. Failing in this, aspiration may be required. Throughout the course of the case, rectal examinations should be made as infrequently as possible. This precaution is by no means gratuitous, for the average surgeon is usually over-anxious to observe the progress of the case, and in his misplaced enthusiasm is apt to do injury. As the acuteness of the inflammation becomes less manifest, counter-irritation by means of iodine or blisters to the perineum may prove of great service. Systematic and repeated blistering may perhaps prevent the supervention of chronic inflammation.

Under careful treatment the inflamed organ will begin to subside and the symptoms will improve in a few days, but it will be several months before the prostate will assume anything like its normal size. The slightest excess is apt to cause a relapse, and the patient will ever after be susceptible to fresh attacks of inflammation—reinfection—from apparently trivial causes. Very insignificant indiscretions are liable to prevent resolution and cause the inflammatory process to become chronic. Prostatitis may consequently be a very unsatisfactory affection to treat, in the most tractable and conscien-

tious patients. Recurrent infection of the urethra simulating a fresh gonorrhœa is one of the most annoying features of the disease.

Abscess.—In a general way the liability to prostatic abscess in the course of acute prostatitis depends upon the assiduity with which the foregoing measures of treatment of acute inflammation are carried out. In cases in which the prostatic inflammation is due to the absorption of pus microbes and their products through an abrasion, or *via* the lymphatics without abrasion, with resulting infection of the interstitial tissue of the prostate, suppuration is almost inevitable. In the ordinary diffuse form of inflammation, however, and in the follicular form which precedes it, energetic and conscientious treatment may avert the development of an abscess. The treatment of acute abscess of the prostate is obviously that of acute prostatitis. When pus has formed or when there exists a strong suspicion of its presence, surgical intervention is absolutely indicated. While conservative treatment by means of poultices to the perineum and the injection of hot water into the rectum may be justifiable in cases in which the presence of pus is extremely doubtful, the practitioner should beware of carrying conservatism too far. Serious results may accrue from a large accumulation of pus in and about the prostate long before fluctuation is manifest. Fluctuation should be carefully sought for, it is true, but in by far the majority of cases operation is demanded long before a sense of fluctuation can be detected in the perineum. In cases in which the abscess involves the periprostatic tissue or opens toward the rectum, digital examination of the gut is likely to detect either well-marked fluctuation or that peculiar œdematous condition which is characteristic of the presence of pus.

As soon as the diagnosis of abscess is justified by the development of a brawny induration and swelling of the perineum, the characteristic œdematous condition, or distinct fluctuation on rectal examination, a free incision in the direction of the prostate should be made in the perineal raphe. This locality should always be selected even where well-marked fluctuation on rectal examination indicates the presence of pus in the periprostatic tissue. Tempted by the close proximity of the pus and the ease with which it was to be reached by the rectum, the author has on several occasions operated through the rectal wall with results which were by no means as pleasant as could be wished, and by no means to be compared with those obtained by the perineal operation. In case pus should not be found by the perineal incision, the surgeon can console himself with the reflection that he has adopted the best possible means to prevent the formation of an abscess, and in case suppuration should eventually occur he has afforded an outlet in the most favorable direction. If

several foci of suppuration be found they should be freely opened and drained. Iodoform gauze drainage should be adopted after evacuation of the purulent accumulation. Infiltration of urine may possibly occur after the opening of an abscess, but it is certainly very rare.

When a prostatic or peri-prostatic abscess is opened from the rectum, or discharges spontaneously into the gut, extensive infection with the formation of ischio-rectal abscess and external fistula or a permanent internal fistula may result. In all cases in which the abscess has been evacuated into the rectum, careful antiseptic irrigation is necessary. Care should be taken, however, to avoid poisoning the patient by too strong antiseptic solutions. Carbolic acid and the bichloride of mercury are particularly open to impeachment on this score. A saturated solution of boric acid is much safer, although necessarily not so efficient. It may become necessary to divulse the sphincter ani to relieve rectal tenesmus or secure perfect drainage. By putting the sphincter at rest, it may be possible to induce healing without the necessity of more serious operative procedures. In the event, however, that a permanent fistula results, it should be dealt with as in ordinary cases of ano-rectal fistula. When the abscess ruptures, or is evacuated by the perineal route, there is danger of permanent urinary fistula. When the pus is evacuated in the direction of the urethra, the repeated formation of peri-urethral abscesses may eventually result in the formation of a perineal fistula. When the pus is external to the prostate in the para-prostatic tissue, there is less danger of infiltration of urine and urinary fistula than in cases in which the prostate proper is involved.

General supportive measures and possibly the administration of stimulants may be necessary after the evacuation of a prostatic abscess. This course should be invariably adopted in cases of prostatic abscess in *prostatiques*. Should pyæmia occur in the course of prostatic abscess, it is likely to be in old cachectic and debilitated subjects, and death is practically inevitable. In cases in which retention occurs from prostatic inflammation or abscess, especially in old subjects, it may be impossible to evacuate the urine with the ordinary form of catheter. The catheter *coudé* of Mercier may be introduced much more readily than the ordinary form of catheter. A soft Nélaton catheter is, in the experience of the author, often unsatisfactory. In passing the elbowed catheter the superior urethral wall is so closely hugged that there is comparatively little danger of penetrating the abscess cavity with the instrument. Instances have been known where the abscess cavity has thus been penetrated and was taken for the bladder. The important fact is to be remembered that it is far

better to evacuate an abscess by an external incision than to produce an internal opening into the urethra or to allow such an opening to occur spontaneously. It is admitted that in many cases in which the abscess opens in the direction of the urethra, the patient recovers speedily and completely, but in a certain proportion of cases permanent infection results with all the dangers of urethritis, cystitis, and recurrent prostatic abscesses.

Chronic Prostatitis.

Considering the frequency of chronic inflammation of the prostate, it is rather remarkable that it was practically unrecognized until the early part of the present century. It must be acknowledged, moreover, that considerable confusion on this subject exists in the minds of clinical observers even at the present day.

Varieties.

Chronic prostatitis presents itself under three forms, namely:

1. The follicular or parenchymatous, involving chiefly the glandular tissues of the organ;

2. The chronic diffuse, involving the lymphatics, connective and muscular tissues of the prostate proper, and also as a rule the tissues of the seminal vesicles and vas deferens, and the para-prostatic tissue;

3. The chronic suppurative.

Etiology.

The causes of chronic prostatitis may be conveniently grouped in the following table:

Predisposing causes	Hyperæmia due to....	Masturbation.
		Sexual desire without gratification.
		Sexual excess.
		Passage of instruments.
		Urethral or bladder disease.
		Prostatic hypertrophy.
		Ano-rectal disease.
		Constipation with consequent straining at stool.
		Frequent defæcation in chronic diarrhœa and dysentery.
		Over-exertion.
		Bicycling and horseback riding.
		Dietetic and alcoholic excesses.
		Exposure to cold.
	Diatheses.....	Gouty, rheumatic, or tubercular.

Exciting causes....	Acute inflammation from any cause, usually from infection.
	Repeated traumatism from urethral instrumentation, or external blows.
	Infection from instrumentation.
	Gradual extension of chronic inflammation from the urethra or bladder.
	Infection by the products of cystitis.
	Infection by pus microbes without traumatism.
	Infection by the bacillus tuberculosis.
	Repeated over-stimulation by irritant applications to the prostatic urethra.
	Over-stimulation by drugs taken internally, as cantharides, turpentine, etc.

It is hardly necessary to expatiate upon the rôle of hyperæmia in the etiology of chronic prostatis. It is not likely that any of the factors enumerated as predisposing causes can when acting alone produce chronic prostatitis. Several of them taken together may, however, act as exciting causes. Thus sexual excess and alcoholism in combination with the gouty or rheumatic diathesis, particularly if associated with exposure to cold, may produce chronic prostatitis. It must be remembered, however, that in by far the majority of cases in which these factors are apparently responsible for the chronic inflammation, some source of infection or of direct irritation of the prostate exists. The more carefully these cases are studied, the more essential infection appears to be in the causation of chronic prostatitis, this being especially true of the follicular form. It is not denied that cases of chronic diffuse prostatitis are met with, especially in middle-aged men, where no history of gonorrhœal or instrumental infection can be elicited. Careful inquiry, however, determines some source of infection in by far the majority of cases. The possibility of auto-infection from deep urethral catarrh, brought on by the numerous predisposing factors which have been outlined, is here to be taken into consideration. Middle-aged patients who present themselves with symptoms of prostatic disease, and in whom upon examination an enlarged, moderately soft, tender, and obviously inflamed prostate is found, are usually gouty or rheumatic, are high livers, and as a rule acknowledge sexual excesses. That such a condition may be the foundation for senile hypertrophy of the prostate is highly probable. In some instances the development of chronic inflammation, particularly of the interstitial variety, is so insidious that the patient's attention is not directed to his condition until many years after the inception of the disease. He may or may not recall a gonorrhœa occurring during his years of indiscretion. If he does recall it, it is generally with the idea that he was perfectly restored to health after the gonorrhœa, when, as a matter of fact, the foundation for his present trouble was laid at that time. Cases are occasionally

met with, on the other hand, in which a history of continuous vesical irritation is related and referred by the patient to his old-time gonorrhœa.

The injudicious passage of instruments into the bladder is oftentimes responsible for chronic prostatitis. The instrumentation acts in two ways: (1) By producing mechanical irritation and hyperæmia; (2) by carrying infection from the anterior urethra to the deeper parts of the canal. The hyperæmia excited by the frequent instrumentation supplies the necessary susceptibility to germ infection. The microbes and their products conveyed by the instruments thus have an excellent culture-bed prepared for them. Irritation of the lower bowel and the bruising incidental to chronic constipation or frequent defæcation in bowel diseases are very potent factors in the production of chronic prostatitis. The slightest infection or exposure superadded to the condition of irritation and hyperæmia already existing is likely to set up a low grade of inflammation which usually becomes chronic. The same may be stated regarding the effects of excessive indulgence in bicycling and horseback riding. The exciting causes of chronic prostatitis which have been enumerated are with few exceptions effective only through the medium of infection. Even in the case of repeated overstimulation of the prostatic urethra by irritant drugs infection may play a very important rôle, secondary, it is true, but none the less important. Infection, however, in such cases is probably not absolutely necessary to the production of inflammation. In the case of chronic suppurative prostatitis it is obvious that pus microbes play the most important part. The pyogenic germs may enter the organ by way of its ducts and glands or by lymphatic absorption. Lymphatic absorption is generally precipitated by traumatic abrasion of some portion of the urethral tract—most generally the prostatic portion. It may, however, in all probability occur through the unbroken mucous membrane. That it may occur by way of the general circulation is shown in certain cases of variola and parotiditis. In such cases the suppurative process is generally an acute one, yet it may be of a chronic character and is very likely to be unrecognized until serious damage has resulted. A fatal issue without special symptoms referable to the prostate is possible.

Chronic Follicular or Parenchymatous Prostatitis.—The nomenclature of this variety is based upon the same proposition which was laid down in the consideration of acute follicular prostatitis, namely, that the secreting glandular structures of the prostate and their ducts constitute the essential anatomical elements of the organ and should therefore be regarded as the true parenchyma. Chronic parenchy-

matous prostatitis necessarily involves the glandular structures of the organ and usually the prostatic urethra, the latter being the point of departure of the inflammation in nearly, if not quite, all cases. The mucous membrane of the prostatic urethra may regain an approximately normal condition, while the glandular inflammation remains for an indefinite period. Chronic follicular or parenchymatous prostatitis embraces a variety of erroneously diagnosed affections. Cystitis, urethral stricture, neuralgia of the vesical neck, posterior urethritis, prostatorrhœa, spermatorrhœa, and catarrh of the bladder constitute some of the diagnoses under which chronic follicular prostatitis is likely to masquerade. The disease may be associated with a certain amount of chronic diffuse inflammation; indeed, the two conditions are quite frequently combined. Many cases are met with in which the glandular inflammation is the essential condition, the interstitial involvement being a subordinate feature and apparently secondary to the glandular disturbance. In some instances chronic parenchymatous prostatitis has been preceded by well-marked acute parenchymatous inflammation associated with diffuse involvement of the prostatic tissue, yet the interstitial inflammation has practically subsided without any appreciable improvement in the glandular inflammation. As has already been remarked in connection with acute follicular prostatitis, this form of inflammation of the prostate has a greater tendency toward chronicity than the interstitial variety.

Chronic follicular prostatitis is usually due to infection and follows as a rule the acute form of inflammation. In by far the larger proportion of cases the patient gives a history of gonorrhœa with some complication which has been referred to the deep urethra, bladder, or prostate. Broadly speaking, a patient who does not give a history of some acute disturbance of the function of micturition during the course of a gonorrhœa is not very likely to be suffering from this form of prostatic inflammation. If, however, such a history be given it is safe to infer that some morbid condition of the prostate is still present. The exceptions to this rule the author believes to be very few. In some few instances, perhaps, the deep urethra becomes infected and the inflammatory process limits itself to the membranous portion of the canal. Such cases, however, must certainly be the exception. In by far the larger proportion of instances the prostatic urethra and almost inevitably the glandular structures of the prostate become involved sooner or later in cases in which deep infection occurs. Once the prostate is infected, whether or not a diffuse inflammation develops, it is the author's firm conviction that a perfect restoration to health never thereafter occurs. The frequency of chronic inflammation of the prostate is much

greater than is generally believed, as may be demonstrated by a careful dissection of a number of prostates taken at random, especially among hospital patients. When we consider the multitudinous glands and ramifications of ducts which constitute the most important part of the prostate and the poor facilities for drainage afforded these tissues, the prolonged duration of infectious processes is by no means remarkable.

The subjective signs of the inflammation depend largely upon the degree and duration of the inflammation of the prostatic urethra. The objective signs depend mainly on the degree of involvement of the interstitial tissue. Careful examination may fail to detect any alteration in the size, consistency, form and sensibility of the prostate even when well-marked chronic follicular inflammation exists. The urinary symptoms having subsided and the prostate having apparently returned to its normal condition, as far as rectal examination enables us to determine, it will still be found that upon the slightest indiscretion or exposure the patient is likely to have attacks of vesical irritation and tenesmus which usually pass as exacerbations of cystitis.

Symptoms.

Chronic Parenchymatous Prostatitis.—The patient usually gives a history of a more or less recent attack of gonorrhœa with complicating deep-seated inflammation which has been referred to the posterior urethra, bladder, or prostate, according to the notion of the physician who has happened to have the case in hand. There is often a history of complicating epididymitis which is sometimes in itself an evidence of prostato-urethral inflammation. The symptoms of irritation of the vesical neck characteristic of follicular or parenchymatous prostatitis may have subsided and the patient may assert that he had been perfectly well for some little time, a relapse having been brought on by indiscretion or exposure to cold. On careful questioning, however, it will be found that slight symptoms referable to the neck of the bladder and the region of the prostate, consisting of more or less weight, voluptuous sensations with slight increase in the frequency of micturition, and in a general way symptoms of hyperæsthesia of the prostatic urethra have persisted since the original acute attack of inflammation. In other instances the patient gives a history of continuous vesical irritation of greater or less degree of severity since the primary involvement of the prostatic urethra. The principal symptoms of which patients complain are frequency of micturition, with more or less pain and perhaps a slight quantity of blood at the termination of the act as the deep perineal muscles con-

tract upon the tender prostate. The urinary symptoms in general are not unlike those of vesical calculus. The sexual function is more or less disturbed. Nocturnal pollutions, premature and perhaps painful ejaculations may exist. The seminal discharges may be mixed with a greater or less quantity of blood. This is especially apt to be the case if the seminal vesicles be involved. A sensation of fulness perhaps with a tinge of voluptuousness in the perineum, itching and tickling sensations in the perineum, urethra, anus, and rectum are often met with. The patient may be annoyed by frequent and persistent erections, and excessive sexual desire may exist. Patients are quite likely to go to the other extreme and complain of complete loss of sexual appetite and of inability to perform the sexual act. More or less congestion or inflammation of the anterior urethra may be present, as a consequence either of simple irritation and circulatory disturbance, or of infection from the deeper portion of the canal; as a result there is more or less oozing of muco-purulent discharge from the meatus. This muco-purulent discharge is more profuse during defæcation and at the end of micturition, and may be noticeable only at such times. It is to be distinctly understood that whenever discharge appears from the meatus during the intervals of micturition and defæcation some morbid condition of the anterior urethra necessarily exists. More or less backache with neuralgic pains along the spermatic cord, in the testes, groins, thighs, and radiating into the urethra may exist. The patient is quite likely to complain of a pain located an inch or so behind the meatus on the under surface of the urethra. This pain is apt to be misleading both to the patient and practitioner, and is very similar to that which is experienced in vesical calculus. The mind of the patient is rarely tranquil, and he is usually imbued with the idea that he has spermatorrhœa, as might naturally be expected. The discharge may contain spermatozoa where the stool is difficult and much pressure is brought to bear upon the seminal vesicles. As a rule, however, it is muco-purulent in character and is composed of pus, mucus, and fatty detritus with more or less epithelium. Where the vesical neck is profoundly implicated, the peculiar ovoid epithelium characteristic of this location is apt to be found.

The urine contains muco-pus and epithelium, the characters varying with the degree of posterior urethritis present. The so-called *Tripperfaden* and the peculiar horseshoe-nail-shaped filaments or flocculi characteristic of inflammation of the prostatic follicles are usually found. Exercise increases the symptoms; there is more or less discomfort attending the act of defæcation, and the patient is very likely to apply for relief for rectal and anal disease, his symptoms

being almost altogether referable to this region. If, as may be the case, the prostatic trouble be complicated by piles, fissures, or fistula, an erroneous diagnosis is quite likely to be made; especially is there an interdependence between the condition of the prostate and that of the ano-rectal region. The writer has at present under observation a patient who states that there is a very peculiar oscillation in his symptoms. When the symptoms referable to the neck of the bladder and prostate are most severe there is less discomfort in the region of the rectum, and *vice versa*.

Chronic Diffuse Prostatitis.—As has already been asserted, the parenchymatous form of the disease is apt to be associated with a greater or less degree of diffuse inflammation. The severity of the symptoms is in direct proportion to the degree of diffuse inflammation present in cases in which the two conditions are associated. The symptoms of the diffuse form are obviously essentially the same as those already outlined, with, however, certain exceptions, due to a difference in the etiology of the case. In cases in which the glandular inflammation follows acute infection, which usually occurs in comparatively young subjects, the principal condition present is one of chronic inflammation of the glands and ducts of the prostate, and the symptoms referable to the urinary and sexual functions are more marked than in those cases occurring in middle-aged men in whom the gouty or rheumatic diathesis, high living, excesses, and a comparatively mild degree of infection are responsible for the condition present. In such patients the urinary symptoms may be comparatively mild until such time as mechanical disturbance of the function of micturition supervenes. In these cases, too, the discharge may not be present, although the urine may give evidence of a chronic inflammation of the prostatic urethra of low grade. In some instances there is not only no discharge but the urine is absolutely normal. While in the parenchymatous form of the disease there may be little or no enlargement of the prostate, in the variety at present under consideration the prostate is distinctly and sometimes considerably enlarged. In both forms of the disease there is more or less tenderness upon pressure in the perineum, and decided tenderness with an urgent desire to micturate on digital pressure through the rectum. The psychic disturbance in middle-aged subjects with diffuse chronic inflammation of the prostate is either subordinate or entirely absent. Aberrations of the sexual function, however, are frequently met with, although they are not likely to be regarded by the patient with the degree of solicitude characteristic of younger men. Digital examination is likely to show in these cases thickening and perhaps tenderness of the seminal vesicles and *vasa deferentia*. This state of diffuse hy-

perplasia may be mistaken for the condition of arterio-sclerosis so strenuously insisted upon by Guyon and his school as the essential feature of prostatic hypertrophy; indeed, it may perhaps lead to arterio-sclerosis with its attendant interstitial fibrosis. The author is firmly convinced that chronic diffuse inflammation is the foundation for many cases diagnosed as hypertrophy of the prostate, and that such chronic inflammation may be the result of abuse of the organ, not only by high living, but by sexual over-indulgence during the patient's earlier life.

Morbid Anatomy.

Some thirty years ago the elder Gross said that the morbid anatomy of chronic prostatitis was something which did not exist. If we were to accept many of the so-called cases of prostatorrhœa as chronic inflammation of the prostate the opinion of this distinguished surgeon might still be accepted as authoritative. As already indicated, however, a large proportion of these cases are not entitled to the term chronic prostatitis, consisting as they do merely of hyperæmia of the prostate with attendant hypersecretion. Inasmuch as chronic prostatitis is not essentially a fatal disease, opportunities for the post-mortem study of the disease are relatively rare. A sufficient number of observations have been made, however, to show not only that chronic prostatitis exists as a pathological entity, but that its morbid anatomy presents well-marked features.

In the follicular or parenchymatous form of chronic inflammation of the prostate there may be little or no alteration in the prostate body, as shown on clinical examination, yet post-mortem section of the tissue shows an increase of consistency of the prostatic tissue incidental to a greater or less degree of periglandular thickening, *i.e.*, interstitial connective-tissue hyperplasia. This interstitial change is more marked in patients toward middle age. It would seem that long continuance of the glandular inflammation eventually determines a greater or less degree of chronic inflammation of a diffuse character. Diffuse inflammation with considerable enlargement of the prostate in men of middle age is in all probability often due to long-continued glandular inflammation, or to chronic hyperæmia. Hyperplasia of the epithelium lining the ducts and glands of the prostate is a constant condition. The lymphatics of the organ may be thickened and hyperplastic. These conditions of thickening and hyperplasia of the glands are likely to lead to an irregularity of contour of the prostate which may be mistaken for tuberculosis. The follicular and racemose glands and their ducts are often dilated, usually irreg-

ularly so. Complete or partial occlusion may occur at certain points, as a consequence of which retention cysts of muco-pus and epithelium may form. The urethral orifices of the prostatic ducts are dilated and thickened as a rule, although in some instances their lumen is more or less contracted. Pressure upon the gland causes the exudation of a muco-purulent fluid mixed with epithelial *débris*. The mucous membrane of the prostatic urethra may be comparatively normal, but it is likely to be thickened, hyperæmic, and possibly granular. This condition of the urethra exists in cases in which chronic prostato-urethritis has been the chief feature of the case. The changes above described are to be expected in practically all individuals who have experienced an acute inflammation of the prostate at some period more or less remote. That such changes are frequent the author has demonstrated by a large number of post-mortem examinations.

Le Dentu has given an excellent description of chronic diffuse prostatitis in a patient thirty-two years of age who died of some intercurrent disease. The prostate was greatly enlarged, the right lobe being especially so. The normal tissue of both lobes was replaced by connective tissue presenting lacunæ varying in dimension from the size of a hemp-seed to that of a large pea. The larger cavities were filled with muco-pus and were evidently formed by the fusion of smaller cavities.

The author's dissections show that in well-marked diffuse inflammation of the prostate, the morbid process involves not only the prostate body proper, but the prostatic urethra, the prostatic glands and ducts, the seminal vesicles, vasa deferentia, and the peri-prostatic tissues which invest the prostate, neck of the bladder, seminal vesicles, and vas deferens. Thickening and induration of the involved tissues are a marked feature. Desnos and Kirmesson have directed especial attention to the thickening of the submucous rectal tissue contiguous to the prostate and to the cellular tissue lying between the latter organ and the rectum. Adenitis with resulting enlargement of the lymphatic glands and a nodular condition of the prostate which may be felt from the rectum is more likely to occur in the diffuse than in the follicular or parenchymatous form. This condition is probably the one which is most often mistaken for prostatic tuberculosis.

In the suppurative variety of prostatitis extreme dilatation of the ducts and racemose glands of the prostate may exist, constituting an advanced stage of the parenchymatous form of inflammation. The pseudo-cysts are distended with the products of suppurative inflammation—*i.e.*, muco-pus, and epithelial *débris*, in conjunction with the

prostatic secretion proper. The prostatic tissue may be relatively atrophied by pressure mal-nutrition, while an actual increase of bulk from the neoplastic formation exists. The cavities formed by occlusion of the prostatic ducts and glands and the accumulation of pathological products within them may open into the substance of the glands, producing infection and extensive abscess formation. True abscesses usually exist in several forms, viz.: *a*. There may be one large abscess circumscribed from the beginning or formed by fusion of several smaller pus cavities; *b*. Disseminated small foci of suppuration may exist; *c*. The peri-prostatic tissue may be the seat of the abscess. In such cases a peripheral prostatic abscess has in all probability ruptured into the peri-prostatic tissue and produced secondary infection in this locality. Thompson has encountered cases in which several abscesses from the size of a grain of sago to that of a large pea were found in the substance of the gland. The prostatic utricle is sometimes dilated and filled with pus. Large or small abscesses often communicate with the urethra, in which event they are likely to contain the products of urinary decomposition. The abscess cavity may communicate with the rectum, perineum, bladder, or urethra. Abscesses may be found where no symptoms of prostatic suppuration existed during life. Civiale relates the case of an old man who was under careful observation in the Hôpital Necker for twenty days. There was no suspicion of prostatic abscess, yet among the many serious lesions of the genito-urinary tract which were found upon autopsy was a large abscess of the left lobe of the prostate. Abscesses of this character may be found in almost any chronic disease of the genito-urinary tract, stricture of the urethra being perhaps most frequently followed by such abscesses. Suppuration may occur as a result of infection from cystitis or prostatic hypertrophy, or vesical calculus. When suppuration has occurred in the course of prostatic hypertrophy or of the treatment for that condition, the prostate presents the ordinary characters of hypertrophy associated with suppuration. In some instances the prostate atrophies completely under the pressure of the pus. The capsule of the prostate and the peri-prostatic tissues under such circumstances undergo fibroid transformation and form a pseudo-cyst containing pus and communicating perhaps with the prostatic urethra. Tubercular deposits may be found in connection with chronic inflammation of the prostate, this condition being classified by some authors as tuberculous prostatitis. The abscess under such circumstances may be due to one or both of two conditions, namely, to caseation of tubercular tissue or to pus infection. Tubercular prostatitis merits fuller consideration, which will be given it under the head of prostatic tuber-

culosis. It is possible that in some cases chronic prostatic abscess is due to suppurative adenitis from mixed infection.

Treatment.

In the follicular or parenchymatous form of chronic prostatitis, the case is to be regarded essentially as one of infection of the mucous membrane of the prostatic urethra, and of the epithelium lining the ducts and follicles of the organ. Its treatment is that of so-called posterior urethritis. It is to be remembered, however, that in some instances the mucous membrane of the prostatic urethra becomes comparatively healthy while the infectious process or its results in the glandular structures of the organ persist indefinitely. By regarding the condition as a chronic follicular prostatitis rather than a posterior urethritis, the disease is likely to be treated upon more logical principles than at the hands of those who believe in an infectious process limiting itself to the posterior or prostatic urethra alone.

The therapeutics of the disease may be divided for consideration into:

A. General. ..	Hygienic and dietetic measures. Remedies having a special action on the genito-urinary tract. Remedies to correct diathetic conditions.
B. Local.	Mechanical, by sounds. Irrigations. Instillations. Medical applications by ointments or soluble bougies.

The general treatment comprises careful attention to genito-urinary hygiene, with especial reference to the regulation of the sexual functions, and the administration of certain remedies having more or less marked special action upon the prostate and the mucous membrane of the genito-urinary tract. There is little hope of securing much benefit from treatment unless the patient leads a life of continence and dietetic abstemiousness.

While from a pathological standpoint a perfect cure of chronic prostatitis rarely if ever occurs, the patient in a large proportion of cases may become practically well, if due consideration be paid to the time element in treatment and judicious instruction in genito-urinary and sexual hygiene be given and conscientiously followed. Dilatation of the prostate by means of the steel sound is curative in a certain proportion of cases in which the inflammation is chiefly parenchymatous or follicular. Caution is necessary in selecting the time for beginning the application of the sound. It is likely to be injurious before the primary acute inflammation has entirely subsided. It is by no means unusual for the early use of the sound to

excite a recurrence of acute prostatic inflammation. Should stricture of the anterior portion of the canal exist, urethrotomy is usually indicated. Strictures at or near the meatus are especially liable to aggravate prostatic inflammation on account of the reflex irritation and hyperæmia thereby excited in the deep urethra and its muscular environment. The first indication, therefore, in cases of this kind, is to free the anterior urethra of all points of irritation and contraction. Many cases of chronic prostatitis previously rebellious to all measures of treatment will yield very speedily after an anterior internal urethrotomy. The results of the operation in these cases are extremely gratifying. The author desires to call particular attention to this feature of certain cases of chronic prostatitis.

Inasmuch as in a majority of cases of chronic prostatic inflammation there exists, either primarily or secondarily, infectious inflammation of the prostatic urethra and the glands and ducts tributary to it, antiseptic treatment in some form is indicated. Internal medication by means of eucalyptus and the various balsamic preparations aids somewhat in antisepsis of the prostatic urethra, but more direct measures are usually necessary to accomplish the desired result. Where it is possible to employ it, deep irrigation by means of a short urethral nozzle is best for this purpose. In by far the majority of patients, after a little training, water can be readily forced from the anterior into the deep urethra and bladder without the aid of either catheter or irrigating tube. In this manner alone can the urethra and bladder be thoroughly irrigated by antiseptic solutions. There are but three remedies which are likely to prove effectual by irrigation. These in the order of their efficiency are, in the experience of the author, *first*, permanganate of potassium; *second*, nitrate of silver; *third*, bichloride of mercury. Permanganate of potassium may be used in the strength of from 1 in 10,000 to 1 in 5,000, rarely stronger. The water should be comfortably warm, not very hot, as it is often used, and should be employed in a quantity of not less than two quarts at each irrigation. In the larger proportion of cases the permanganate of potassium is quite effectual. Sometimes, however, it has little effect, in which event the nitrate of silver in weak solutions often acts admirably. The solutions ordinarily recommended are too strong. From one-half to one per cent is usually quite as concentrated as the urethra and bladder will tolerate. It is worthy of remark that a half-per-cent solution by means of copious irrigation excites more pronounced reaction in the deep urethra and bladder than do much stronger solutions used by instillation.

Instillations of antiseptic and astringent remedies by means of the deep urethral syringe come next in order. They are highly extolled

by many of our genito-urinary authorities, yet nevertheless they are often disappointing. As made with an ordinary Ultzmann syringe the application of a few drops of nitrate of silver solution to the prostatic urethra for the cure of follicular prostatitis, or so-called posterior urethritis, is the height of absurdity. The area medicated by the solution is but a small part of that which is infected, and a few drops of a more or less powerful solution of nitrate of silver are not likely to accomplish much good. Where the instillation method is used at all, it should be by means of a syringe holding a drachm or two of fluid. The orifices in the injecting tube should be numerous, this arrangement enabling the fluid to escape in the prostatic urethra simultaneously in all directions, flushing this portion of the canal thoroughly. Such a syringe is very convenient in cases where we desire to leave a certain quantity of antiseptic or astringent fluid in the bladder. Nitrate of silver, bichloride of mercury, sulphate of thalline, and choloride of zinc are the most reliable of the remedies in vogue for instillation. Astringent and antiseptic remedies applied by means of ointments or soluble bougies are often of marked service. Iodoform is probably the most valuable medicament for use in this manner. Nitrate of silver in combination with lanolin, five to twenty grains to the ounce, is also frequently efficacious. Local medication of the prostate *via* the rectum is also of service. Iodoform, europhen, and ichthyol in combination with anodynes are often found efficacious in assisting in the cure of the chronic inflammation. They are especially indicated where well-marked diffuse inflammation exists. In such cases also massage of the prostate and seminal vesicles *via* the rectum sometimes proves beneficial. Counter-irritation to the perineum in the form of blisters is one of the most valuable adjuvants to the treatment. Frequently repeated hot rectal injections in combination with hot sitz-baths are of service. In obstinate cases, prolonged rest in bed meets a very important indication. Many cases of chronic inflammation of the prostate may be completely cured in this manner. Few cases indeed will resist from four to eight weeks' complete rest in the recumbent posture. Due attention should be paid to the condition of the bowels. Hepatic torpor especially must be counteracted. The pelvic circulation, in short, should be kept as active as possible by appropriate remedies. In very serious cases of well-marked diffuse chronic inflammation, a cure may be brought about in a large proportion of instances by putting the prostate and neck of the bladder completely at rest by means of combined suprapubic and perineal section with through-and-through drainage. Drainage by the perineum should be kept up for a couple of weeks, after which time the suprapubic opening alone is to be relied upon. Speedy subsidence

of the prostatic inflammation is to be expected in most cases. The author unhesitatingly recommends this method of treatment in stubborn cases, especially those occurring in men at or about middle age.

It is unnecessary to enumerate the various internal remedies which are likely to prove of value. Anaphrodisiacs, ergot, and most of the other remedies which have been enumerated as efficacious in hypertrophy of the prostate, and some of those recommended in acute inflammation of the organ, may any of them be quite beneficial.

One of the most important points regarding chronic inflammation of the prostate is the fact that the follicular form of gonorrhœal origin may afford an infectious secretion for a prolonged period. A patient who has been apparently well for many months may infect the female, not necessarily with true gonorrhœa, but with some form of mucous inflammation which is a derivative of the original true specific process. The patient should be duly impressed with this feature of his disease, else he may not appreciate the necessity for prolonged treatment and attention to hygienic rules.

Tuberculosis of the Prostate.

Tuberculosis of the prostate was recognized many decades ago by the great French clinician Louis. The first contribution clearly setting forth its pathological anatomy was that of Verdier.

Since the appearance of Verdier's brochure on prostatic inflammation a large number of contributions upon the subject have appeared, and tuberculosis not only of the prostate but of the genito-urinary tract as a whole is fairly well understood as a definite morbid entity.

The subject has been much more clearly defined since the establishment of the germ origin of disease upon a firm basis. It must be confessed, however, that in certain quarters a knowledge of the possibility of primary and secondary tubercular involvement of the prostate has added an element of confusion to the study and treatment of prostatic disease. As is usually the case with all new fields of pathological research, genito-urinary tuberculosis has become somewhat of a fad, and it is becoming quite fashionable among practitioners to classify most of the obstinate chronic cases of genito-urinary disease which come under their observation as tubercular. This will be refered to again later.

Varieties.

Prostatic tuberculosis occurs in three forms, which are clinically quite readily differentiated where a positive diagnosis is possible.

These are: (1) Primary, in which no focus of infection more or less distant is discoverable; in these cases there is usually chronic follicular inflammation upon which the tuberculosis is ingrafted; tubercular disease may, however, occur without any pre-existing symptoms of chronic inflammation; (2) Involvement of the prostate secondary to tuberculosis in distant organs, the infection occurring by way of the general circulation; (3) Prostatic tuberculosis secondary to disease of contiguous and correlated tissues or organs. The latter is the most frequent. With regard to the primary form, it is open to question whether antecedent chronic inflammatory disease is not a necessary factor in the etiology.

Etiology.

In the primary cases it is possible that an hereditary or acquired tubercular predisposition may exist. But the most important and determining factor is usually chronic follicular inflammation. That the general health of the patient is usually below par, is a matter of almost universal clinical experience. In such cases the point of lessened resistance to bacillary infection is afforded by the long-continued chronic inflammation. In some cases the patient has either had no antecedent inflammation or he has been subject to acute deep-seated inflammation involving the prostate and posterior urethra which has so long subsided that it seems unwarrantable to attribute the symptoms of tubercular infection to the almost forgotten gonorrhœal infection. In such cases it is possible that the tubercular infection is not preceded by chronic inflammation. It is probable, however, that hyperæmia from sexual excesses, ungratified desire, or alcoholism, or any cause of pelvic or prostatic congestion associated with constitutional debility, may prepare the soil for infection. More often the prostatic tuberculosis is secondary to tuberculosis of associated organs, such as the penis, testes, bladder, kidneys. Secondary infection from testicular tuberculosis is the most frequent of all. Involvement of the prostate as a secondary feature of renal tuberculosis may occur in one of two ways: (1) By the lodgment of the bacilli carried downward by the urine; (2) In the same manner as in tuberculosis of the lungs, by infection through the general circulation. Prostatic tuberculosis secondary to infection of distant and unassociated organs is obviously not of so great clinical importance as the preceding varieties, inasmuch as the primary infection, especially of the lungs and peritoneum, is usually intrinsically fatal, the prostatic tuberculosis being therefore chiefly of pathological importance, aside from attempts at palliation of the local urinary difficulty.

Morbid Anatomy.

This is essentially the same as in tuberculosis of other organs and tissues. The characteristic gray and yellow tubercles, cavities, diffuse infiltration and miliary deposits, cretaceous degeneration, fibro-sclerotic change, and cicatrization of cavities are all found in different cases at different stages of the disease. It is a noteworthy fact that the more pronounced lesions are likely to be found in primary tuberculosis of the prostate, or in that form which is secondary to disease of contiguous and correlated organs. Patients with prostatic tuberculosis secondary to pulmonary or other serious forms of tubercular disease die from the general affection as a rule long before the prostatic tuberculosis has time to develop serious lesions.

A greater or less degree of enlargement of the prostate is likely to be found sooner or later in prostatic tuberculosis. Enlargement appears earlier in cases in which the periprostatic lymphatics and glands are primarily involved, or in which there is primary interstitial deposit, than in those in which the first manifestation of the disease consists of a tubercular prostatitis limited primarily to the mucous and submucous tissues of the prostatic urethra. The enlargement may be diffuse, or limited to one or the other lobe. Rarely, if ever, is it symmetrical. The enlargement is due to two factors: First, a deposit of tubercular elements, and second, consecutive inflammation and interstitial proliferation of young connective tissue. It is obvious that the ordinary features of prostatic tuberculosis may at any time be modified by acute inflammation or abscess from mixed infection or traumatism.

In primary prostatic tuberculosis the enlargement is likely to involve both lobes, although unequally. In the secondary form of the disease one lobe only may be affected, although later in the course of the disease both may become involved. In cases secondary to tuberculosis of the testicle, or in which one testicle only is enlarged as a condition secondary to a deposit in the prostate, only one lobe of the prostate is likely to be implicated, at least primarily. In some cases in which the prostatic disease is secondary to general tuberculosis, gray granulomatous deposits may be the initial process. It would appear, however, that most often the initial deposit consists of characteristic yellowish granulomatous nodules. These undergo sooner or later more or less softening, and perhaps become liquefied, forming the so-called tubercular abscess, the characters of which may closely approximate ordinary abscess or true suppuration, provided secondary infection with pus microbes occurs. The caseating nodules or the yellowish granulomatous nodules may remain comparatively

quiescent for a long time. In cases in which secondary mixed infection occurs, and pus microbes play the most important rôle, the process may assume a more or less acute form and a mistaken diagnosis is likely to be made.

Primary tubercular deposit most generally occurs about the acini of the glands. It may, however, first invade the submucous tissue of the prostatic urethra. The deposit soon undergoes caseation, with the final invasion of the epithelium of the prostatic urethra and resulting ulceration and perforation of greater or less extent. This constitutes the so-called tuberculo-ulcerative prostatitis, and is the form in which a positive diagnosis is most easily made. In other instances a caseating cavity at some distance from the mucous membrane softens and burrows from the free surface, finally opening into the urethra. Abscess cavities and ulcers of the prostatic urethra are soon followed by secondary mixed infection and perhaps by infiltration of urine, urinary abscess, and fistula. These lesions present no tendency to cicatrization and spontaneous cure. When the entire gland or one entire lobe is involved, the process may extend chiefly toward the rectum. Nodules are found in the substance of the gland and are perceptible on rectal exploration. These may be softened down and with or without secondary mixed infection form tubercular abscesses which open into the periprostatic cellular tissue, constituting chronic periprostatic abscess, and eventually into the rectum. They may burrow upward and laterally, forming large tubercular cavities in the prerectal tissues. In other instances they may open into the urethra, after which ordinary urinary abscess forms. Several caseating foci may coalesce, forming one large irregular cavity with rigid and perhaps eventually calcareous walls. Calcareous transformation or fibro-sclerotic change of the walls of the cavities with resorption of their contents and eventually fibroid degeneration and contraction of the entire mass occur exceptionally and result in a spontaneous cure. In such cases the condition of the prostate is one of atrophy, cicatricial contraction, and partial destruction of the normal glandular and muscular tissue.

In extreme cases of tubercular abscess the entire gland is represented by a pus sac. This may or may not invade the urethra. When it does so, the urine enters the cavity, decomposition, local and perhaps septic infection, and a more or less acute urinary abscess may result. The sinuses which form as a result of tubercular abscess may burrow in various directions. They most often open upon the perineum in the neighborhood of the anus; their next most frequent direction being toward the rectum, into the cavity of which they finally open. They have been known, however, to open in the

hypogastric region or some distance away upon the abdominal walls, or thighs. A small primary focus or perhaps several small tubercular foci may remain quiescent in the prostate for many years, possibly for an indefinite period. This explains the extremely slow progression of many cases in which a diagnosis of prostatic tuberculosis is made, admitting that quite a proportion at least of such diagnoses are correct. The rule is, however, that general infection and a fatal result occur sooner or later. It is obvious that a fatal result occurs much earlier in cases in which the prostatic disease is secondary to tuberculosis of other and more important organs.

It is not easy to determine the primary seat of infection in prostatic tuberculosis. It is often a very perplexing problem to decide whether the primary deposit occurred in the prostate or in some other organ or tissue of the body. Even when secondary to tuberculosis of contiguous and correlated organs and tissues, it is not always a simple matter to determine the precise relation between the prostatic and the contiguous disease, *e.g.*, if the prostatic tuberculosis is associated with a similar process in the testicle, it is not always easy to determine which organ was the primary seat of the disease. From a clinical standpoint, it is probably most generally believed that the prostatic disease is secondary to that of the epididymis. In many cases, however, it seems logical to infer that the tubercular infection has travelled from the prostatic urethra *via* the ejaculatory duct and vasa deferentia to the epididymis. This may be inferred when the symptoms of prostatic disease precede for some time the morbid changes in the testicle, and where both epididymes are involved at about the same time. It must be remembered, however, that small tubercular nodules and slight infiltration of the epididymis may exist for a long time prior to the development of prostatic symptoms without attracting the attention of the patient, the first manifestation of disease from the objective standpoint being referable to the urinary function. From a pathological standpoint, it is said to be fair to infer that when the process in the prostate is far advanced and that in the testis is insignificant, the prostatic tuberculosis may be considered to be the primay condition. This, however, is not to be accepted without qualification, inasmuch as the process in the testicle is always slow, often comparatively innocuous, and not likely in a large proportion of cases to go on to extensive destruction unless some source of mixed infection occurs.

The condition of the spermatic cord is apparently not a fair criterion from which to decide the primary or secondary relation of the prostatic to the testicular disease where these two conditions coexist. It would appear that infections of all kinds may expend their violence

upon what may be termed from a practical standpoint the two extremities of the seminal tube, the cord remaining healthy. Tubercular adenitis and lymphangitis are very important factors in prostatic tuberculosis. As Lannelongue pointed out, the lymphatic glands between the bladder, prostate, and rectum may be the point of departure. In such cases speedy softening with early opening into the rectum may occur. In some cases of prostatic tuberculosis there is general genito-urinary infection, primary or secondary. The kidneys, bladder, and ureters may be involved, the infection having travelled up from the prostate to the kidneys or *vice versa*. Instead of this gradual extension of the disease upward or downward, the kidneys may be the primary seat of tubercular deposit, the prostate presenting secondary tuberculosis as a consequence of bacillary infection either by the urine or in a more roundabout way through the general circulation.

Symptoms and Diagnosis.

When the prostatic urethra is the seat of a tubercular deposit —with or without involvement of the bladder—the symptoms are essentially the same as in any chronic inflammation in this region. Pain referred to the region of the bladder, perineum, thighs, groins, urethra, testes, and rectum may be complained of in different cases. Frequent and painful micturition, increasing in severity as the vesical neck becomes invaded, is the most uniform symptom. Some hæmaturia is observed. This is not profuse as a rule, but is limited to the last few drops of urine. Sometimes, however, it is moderately free, and if the urethra is involved anterior to the triangular ligament urethrorrhagia may be observed. The fusiform clot characteristic of prostatic hemorrhage is sometimes seen. Acute retention of urine may occur from the supervention of hyperæmia, simple inflammation, or the formation of a mixed abscess. The urine contains muco-pus, epithelium, thready filaments, and, if ulceration exists, particles of tuberculous tissue are sometimes observed. A chronic prostatic or recurrent discharge of a muco-purulent character is present where the prostatic urethra is involved. Bacilli may or may not be present, but are rarely to be observed unless ulceration or abscess exists. In a general way, the discharge is that of a stubborn so-called posterior urethritis—*i.e.*, follicular prostatitis. The discharge of muco-pus is likely to be intermittent, occurring only at stool, during the *coup de piston*, or on digital pressure through the rectum. When the discharge escapes spontaneously from the meatus, the anterior urethra is also involved, not necessarily in a tubercular urethritis, but in most cases being the seat of simple chronic inflammation. Sometimes a

large quantity of pus suddenly appears in the urine. This is indicative of the evacuation of the abscess *per urethram*.

When the tubercular deposit is at the periphery of the prostate or in the periprostatic tissue, there may be no symptoms for a long time. The patient is not likely to complain unless the bladder, urethra, or testes become involved. There may be some pain and weight in the perineum, with tenderness upon pressure, a moderate amount of rectal tenesmus and pain in defecation, but these symptoms are usually noticeable only after a sufficient amount of tubercular material has become deposited to produce more or less mechanical disturbance.

As will be observed, there is nothing pathognomonic in the foregoing symptomatology. The most definite symptoms are of an objective character and are to be determined by rectal exploration. The prostate is found to be the seat of an irregular nodular enlargement with perhaps areas of softening. A granular feel of the periprostatic tissue has been described. The seminal vesicles are sooner or later involved as a rule and are thickened, nodular, and tender. A definite abscess may be found. After evacuation of the tubercular abscess relative atrophy and perhaps sclerosis of the prostate are observed. The passage of the catheter may result in the detection of the abscess cavity, usually upon the floor of the prostatic urethra.

It is obvious that it is quite easy to make diagnostic errors where there is no softening or ulceration of the prostate. The presence of bacilli in the urine or pathological discharge from the affected organ constitutes the only positive sign of tuberculosis. Since so much has been written upon tuberculosis of the genito-urinary tract, many mistakes of diagnosis have been made. Among some surgeons the presence of more or less hardness of one or the other epididymis with a little enlargement, tenderness, and nodulation of the prostate are sufficient to warrant a diagnosis of prostatic tuberculosis. It must be remembered, however, that simple chronic inflammation of the epididymis may present the same signs as far as the testes are concerned. Simple adenitis—periprostatic adenitis with chronic follicular prostatitis—may afford all of the other signs upon which the diagnosis of tubercular disease of the prostate is frequently based. In the experience of the author, it is nothing unusual to meet with such cases that have been diagnosticated as tuberculosis of the prostate. Under the ordinary measures of treatment of follicular prostatitis many of these cases readily yield. The inference is obvious—either many cases of tuberculosis of the prostate constitute a mild and comparatively harmless affection, readily amenable to treatment, or else frequent mistakes in diagnosis occur.

When a sluggish, slowly developing, comparatively painless and insensitive enlargement of one or both epididymes exists with symptoms of chronic prostatic inflammation and a nodular enlargement of the prostate, as determined by rectal examination, a probable diagnosis of prostatic tuberculosis is warrantable. The detection of bacilli in the urine or discharge, or the formation of characteristic tubercular abscesses and sinuses, are necessary as a rule for a positive diagnosis. In a case presenting similar symptoms as far as the prostate is concerned, and at the same time evidences of tuberculosis of the lungs, peritoneum, bones, or general lymphatic system, the inference regarding the prostatic disease is obvious. The heredity of the patient and his general condition are important factors in the diagnosis.

There is no regularity in the course of the disease. Some patients suffer very acutely at an early period where the urethra and bladder are involved. Others, especially when the urethra is not primarily or early invaded, tolerate the condition for a very long time. Complete arrest of the disease and a spontaneous cure may result, as is indicated in the discussion of the morbid anatomy of the disease.

Treatment.

Where prostatic tuberculosis is secondary to disease of other important organs, the treatment is that of the primary disease, excepting in so far as local measures of palliation may be instituted. Where it is primary or secondary to tuberculosis of contiguous organs, the treatment of the local difficulty assumes a more prominent position. The general treatment of the disease should be based upon the same principles as tuberculosis elsewhere, due consideration being given to tonic and alterative treatment, nutrition, and change of climate. The method of hypodermic medication by iodine and chloride of gold in the form of Clark's solution offers some hope of benefit or even cure. The local treatment should consist first of irrigation of the bladder and prostate with a warm solution of boric acid, followed by the instillation of iodoform emulsion. Iodoform in the form of rectal suppositories has seemed beneficial. Instillations of nitrate of silver and other irritant astringent drugs are rarely beneficial, and are most likely to prove injurious; it has even been asserted that such treatment may precipitate ulceration. When possible to do so, it is best to irrigate the bladder and prostate by means of a short urethral tube rather than by instruments which necessitate more or less mechanical irritation of the prostate. Although the practice is not universally accepted, the author is convinced that putting the bladder at rest and providing through-and-through

drainage at an early period of the disease is likely to prove curative in quite a proportion of cases. When abscesses form they should be evacuated, scraped, and packed with iodoform gauze; all sinuses should be thoroughly curetted and treated with iodoform. Interstitial injections of iodoform emulsion into the affected gland constitute a logical method of treatment and are likely to prove of curative value. Cases are reported where large tubercular abscesses of the prostate have been opened, curetted, and drained with resulting cure, but in marked cases of prostatic tuberculosis recovery is rare. Sooner or later, the bladder, kidneys, or distant organs become secondarily affected. When prostatic tuberculosis is secondary to tubercular disease in other important organs the death of the patient is inevitable.

Cancer of the Prostate.

Malignant disease of the prostate is rare, yet it is probably more frequent than is ordinarily supposed, the condition being often erroneously diagnosed. Malignant disease of the prostate occurs in two forms, namely, sarcoma and carcinoma. It is found at the two extremes of life, it being exceptional between the ages of ten and fifty years. It is occasionally found in very young children. In something over eighty-five per cent of cases the malignant affection assumes the form of carcinoma, the remainder being of a sarcomatous character. Sarcoma is the form which is most likely to be met with in young patients.

Cancer of the prostate occurs in three forms: First, primary; Second, as an infection secondary to malignant disease of contiguous organs; Third, by infection through the medium of the blood. The form which is most often seen is secondary to malignant disease of the penis, testes, bladder, or kidneys. As Guyon has shown, primary prostatic cancer has but little tendency to invade the bladder, but speedily involves the lymphatics, especially those of the pelvis. This latter clinical fact suggested to Guyon the term prostato-pelvic cancer. The disease may be at first circumscribed. It is usually, however, diffuse. The capsule of the gland may alone be affected, at least primarily. Eventually extensive pelvic invasion occurs with involvement of the seminal vesicles, base of the bladder and sometimes its mucous membrane, the rectum, and urethra. Mixed infection and suppuration may eventually occur.

Symptoms.

Frequent and painful micturition with hæmaturia, and if ulceration of the prostate exists, more or less purulent discharge, consti-

tute the main features in the symptomatology of the disease. The pain is likely to be most severe at night, and is often referred to the region of the rectum. As the pelvic tissues become extensively involved, pressure, irritation, and resulting pain in one or both sciatic nerves is likely to develop. Intrapelvic pressure also may produce more or less obstruction of the iliac veins with œdema of the limbs. Constipation from mechanical pressure upon the rectum may be observed. Marked cachexia comes on at a comparatively early period. A fatal result is inevitable.

Diagnosis.

In the differential diagnosis, tuberculosis and prostatic hypertrophy only are worthy of consideration. A hard nodular enlargement of the prostate with cachexia, pronounced symptoms referable to the vesical neck, and extreme pain suggestive of pelvic involvement, taken in connection with enlargement of the pelvic lymphatic glands and those of Scarpa's triangle, warrant a diagnosis of cancer. When cancer exists elsewhere in the body, and especially if it has invaded organs contiguous to, or correlated with, the prostate, the diagnosis is a very simple matter.

Treatment.

Treatment must necessarily be palliative. All radical attempts at surgical relief have thus far failed of their object. The author believes that early suprapubic section and the establishment of a permanent artificial urethra is the principal surgical indication. Great relief of some of the most annoying symptoms of the disease and prolongation of life are likely to result from the rest and freedom from mechanical irritation thus afforded the affected part.

Calculus of the Prostate.

Varieties.

Prostatic concretions or calculi are sometimes seen. These occur in four forms:

1. A variety due to inspissation of the secretion of the prostatic follicles, in combination with the deposition of earthy salts;
2. Small calculi of urinary formation, which have formed in the kidneys or bladder and have become lodged in the prostatic urethra;
3. Calculi due to the deposition of urinary salts and mucus in some pathological crypt, or behind some obstruction of pathological formation in the prostatic urethra;
4. Phleboliths.

Morbid Anatomy.

Concretions of the first variety are found in the prostate post mortem, in cases in which there have been no symptoms referable to the organ during life. Minute concretions of this kind are sometimes found in the urine. They are first of microscopic size, and in the majority of cases never attain sufficient dimensions to be of any practical importance. As seen with the microscope, they are small, ovoid bodies of a light yellow tint and pearly lustre. In the large concretions the color is a dark orange. When first formed they are soft, but later on they become petrified and hard. They are precisely similar to the concretions which form in the follicles of the tonsil and which are occasionally coughed up by patients with chronic faucial disease. In elderly patients they may attain the size of a pea or larger, and may be very abundant. Thompson describes a case in which several thousand of these concretions were visible microscopically. They are found in the secreting follicles and excretory ducts, constituting the parenchyma of the prostate. The earthy material is deposited very slowly, in concentric laminæ, as is the case with phosphatic vesical calculi. The walls of several ducts and follicles may be absorbed and form a single cavity within which a number of such concretions may be found. When they become larger and the opening of the cavity within which they are contained communicates freely with the prostatic urethra, the salts of the urine are deposited about them, and they become genuine prostatic calculi. Cases have been reported in which the entire prostate was converted by absorption into a sac completely distended with small calculi, which could be felt rolling under the fingers like beans in a bag. Prostatic calculi sometimes fuse together and form a sort of cast of the prostatic ducts and urethra. A length of four or five inches has been said to have been attained. Thompson refers to a case in which there were nine fragments weighing altogether three and one-quarter ounces. Chemically, true prostatic calculi are composed chiefly of calcic phosphates and a small quantity of ammoniaco-magnesian phosphate. They never give rise to trouble unless they are exceptionally large, in which event they occasion a certain amount of mechanical disturbance and urinary obstruction.

Treatment.

Prostatic calculi should not be disturbed, even where their existence is recognized, unless they give rise to definite symptoms or lie within easy reach. If they are removed, it should be by perineal

section. They may cause abscess, and finally be discharged into the urethra, bladder, perineum, or rectum.

Calculi are often found in the tissues about the prostate and neck of the bladder at some distance from the prostate proper.

Hypertrophy of the Prostate.

Hypertrophy of the prostate is the most important morbid condition of this organ which comes under the observation of the general practitioner. A large proportion of individuals past middle age are subject to it, and those so affected are most likely to come primarily under the notice of the medical man rather than the surgeon. Upon the management of the case, at the time when it first comes under the observation of the physician, the safety and future comfort of the patient largely depend. Simple measures of exploration and palliation at the hands of many general practitioners are far more dangerous on the average than radical operations undertaken under like circumstances by the surgeon, because of the difference in technique from the aseptic standpoint. It is of the greatest importance, therefore, for the physician to thoroughly understand the disease, and more especially to appreciate the relation of bacterial infection to the morbid conditions produced by the prostatic enlargement.

Etiology.

Few pathological conditions indeed have been the subject of a greater variance of opinion as to their etiology, than enlargement of the prostate. The opinions of authorities have varied from the agnostic assertion that in the present state of our knowledge we are unable to determine positively the cause of the condition, to opinions as dogmatic as could be imagined. It is a noteworthy fact that most of the modern theories are fully as open to criticism as some of the more ancient views. Thus there is much of logic in the opinion of Home, who some seventy-five years ago promulgated the theory that the principal cause of prostatic disease was slow return of blood from the neck of the bladder, arising from the disadvantageous situation of the veins as regards their relation to the heart, which favors habitual congestion of these vessels. He held the opinion that this tendency to congestion was enhanced by high living, or any other circumstance which increased the circulation of the blood in this region. Home believed that traumatism, such as is incidental to horseback riding, sometimes produced in deeper parts of the prostate a rupture of blood-vessels which was subsequently followed

by hypertrophy. This rupture of vessels he believed to be in some measure analogous to apoplexy. He also assigned to old age a prominent rôle in the production of hypertrophy of the prostate.

Wilson, in 1821, indorsed the opinion of Home so far as the tendency to the disease on the part of high livers was concerned. He seemed to think that strict celibacy on the one hand, and venereal excess on the other, were alike potent in the production of the disease, although he admitted that exceptional cases occurred in which enlargement of the prostate developed in people who lived abstemious and temperate lives.

Sir Charles Bell asserted the existence of a predisposition to prostatic enlargement, but did not state what constituted or caused this predisposition. Admitting that such predisposition existed, he believed that the exciting causes were associated with irritation of the bladder and the resulting frequent contractions of that viscus. As a consequence of these contractions of the bladder, he believed that the urethral muscles were the seat of over-action, the result of which was to draw back the so-called median lobe in such a manner as to elevate it and constitute obstruction to the escape of urine.

Samuel Cooper frankly confessed that the causes of prostatic hypertrophy were unknown. He seemed to think from his experience, however, that people who led sedentary lives were more liable to the affection than others.

Astley Cooper arbitrarily stated that hypertrophy of the prostate was the consequence of old age alone, and not of disease.

Brodie seemed to think that enlarged prostate was a matter of course in old men. He believed that prostatic hypertrophy never becomes manifest until plainly marked evidences of senility have developed.

The late Dr. Gross expressed himself to the effect that prostatic hypertrophy might result from habitual engorgement of the organ incidental to protracted and repeated sexual intercourse, irritation from a vesical calculus, the free use of stimulating diuretics and alcoholic or malt liquors, exposure to cold, the suppression of cutaneous diseases, gout and rheumatism, or traumatism, to the frequent introduction of the catheter, and to habitual straining at stool, as in chronic diarrhœa and other affections of the bowels.

Mercier classed as predisposing causes all conditions and influences which favored sluggishness of the circulation. According to him, men of lymphatic habit, with plenty of cellular and adipose tissue, have generally a lax and unresisting venous system. Such subjects, he claimed, are most frequently the victims of prostatic enlargement. He believed that sedentary habits favor the disease.

Amussat stated that syphilis, a foreign body in the bladder, and stricture of the urethra were the most common causes of prostatic enlargement. It is observed, he claimed, chiefly in elderly persons who have for a long time used sounds or bougies upon themselves.

Desault held that enlarged prostate was very common in elderly men and those who have had numerous attacks of gonorrhœa. He also believed that the disease might bear a certain relation to scrofula and other cachexiæ.

Civiale, in discussing the etiology of prostatic hypertrophy, placed vesical calculus first in the order of prominence. Second only to vesical calculus, he considered organic stricture of the urethra. He denied the relation of venereal excesses to chronic prostatic disease.

Coulson contents himself with the presentation of the views of others and has no definite opinion of his own.

Thompson expresses himself in the most unequivocal fashion as believing that prostatic enlargement is seen in young patients; the organ in such cases becoming enlarged by interstitial plastic effusion, the result of inflammatory action, while in old age there is unnatural development of the prostatic tissue proper, *i.e.*, true hypertrophy. According to him the action of inflammation and its products does not favor growth, but is directly antagonistic to such a process. A prostate, therefore, which has been enlarged by inflammatory effusion is, according to Thompson, probably less likely subsequently to exhibit an hypertrophic tendency. Nutrition is thus impeded, not encouraged. In brief, Thompson feels warranted in excluding inflammation from the list of causes. Urethral stricture and calculus are not considered by him to be of great importance in the etiology of prostatic hypertrophy. He does not believe that habitual engorgement of the prostatic and hemorrhoidal plexuses has much to do with the etiology of the disease. "True hypertrophy," according to him, "in any situation never has venous congestion for a cause; venous congestion impairs structure and predisposes to ulceration of the tissues affected by it, but it never augments vital force or stimulates growth." Upon this ground Thompson denies congestion as a possible ground of hypertrophy of the prostate. He further disputes the possibility of rheumatism, gout, or syphilis playing any part in the pathological process. Regarding the effect of sexual excesses, he says: "Much influence has been attributed to the effect of habitual indulgence of this kind; but from the fact that the affection has been observed to occur in individuals known to have been remarkable for chastity, the opposite extreme of continence has been regarded as exercising a similar influence. In regard to the first, it appears reasonable to believe that repeated use might induce

hypertrophy here as elsewhere. Without entering upon the question of the prostatic function, it is impossible not to associate the organ with the sexual act, and admitting this it appears not to be easy to escape the inference that hypertrophy is likely to result from sexual excess; yet facts do not favor this view. Hypertrophy does not exist when the function is in greatest vigor and is not called into immediate existence by the most licentious excesses indulged in during the prime of life, and it must be admitted that in any part of the body hypertrophy develops itself coincidentally with, or at all events immediately follows, the increased action which induces it."

Although Thompson disputes the view that the prostate is truly a secreting gland, he admits it for the sake of argument, and claims that no other gland offers a pathological parallelism with hypertrophy of the prostate; all of its component issues not being increased in their relative proportions. An enlargement of the gland may be due to an increase of glandular elements; or, on the other hand, to a change in the structure and an increase in the bulk of the "prostatic tissue proper." Thompson does not believe, furthermore, that an enlargement of the prostate is a simple muscular hypertrophy induced by increased action. He called attention to the close similarity between the uterus and the prostate, and seems to think that "just as during the latter part of the period of reproductive activity the uterus is prone to develop new growths identical in structure with its own, a similar tendency will be found to develop new growths in the prostate at a corresponding period in life of the male." Thompson's tables apparently support the view which he promulgates by showing that hypertrophy of the prostate is a disease incidental to old age, but he fails to make clear the precise connection between advancing age and the development of prostatic hypertrophy. Even granting that old age is the chief factor in the production of the disease, there is yet much to be accounted for. Why should so large a proportion of elderly men present a condition so distinctly pathological, affecting an organ which in old age at least should be practically of no importance from a physiological or functional standpoint? Thompson himself admits that hypertrophy of the prostate is not necessarily or even usually present in old age, but is rather an exceptional condition. According to him, a slight tendency to hypertrophy of the prostate undetermined during life may exist in about one in three individuals after sixty years, and that a marked enlargement may be met with in any one out of seven or eight after that age. Among forty prostates of elderly men dissected by Thompson only 32 per cent were appreciably enlarged, and but 2 per cent sufficiently so to have produced symptoms during life.

The modern French school, following the distinguished Guyon, entertains the peculiar view that enlargement of the prostate is not a local condition and the effect of local causes, but that all the urinary organs, and particularly the bladder, undergo changes of analogous character, the origin of which should be looked for in structures bearing absolutely no anatomical relation to the urinary system; implying, in short, that enlargement of the prostate is dependent upon general atheroma. Thus this school claims that the walls of the bladder fail in their power with a resulting accumulation of residual urine followed by cystitis, prior to the enlargement of the prostate. Reginald Harrison has also asserted that the habit of partial retention frequently precedes the vesical signs of prostatic enlargement, the depression of the posterior wall of the bladder being a primary change. In this the author heartily concurs. Harrison further holds that the depression of the posterior wall of the bladder results in a compensatory hypertrophy which determines the development of a strong muscular band or buttress at the base of the trigone, and finally enlargement of the prostate itself.

It is obvious that even though we admit that, in certain cases, depression of the floor of the bladder and alteration in the walls of the viscus precede perceptible pathological change in the prostate, this condition may in no way be causative of the prostatic disease. I contend that such cases are no argument against what appears to me to be the correct view, viz., that serious pouching of the bladder is generally a secondary condition. General atheroma, for example, with a resulting alteration of the structure and power of the bladder, might occur and subsequently become associated with hypertrophy of the prostate, which condition is due to the same causes as in other cases in which prostatic hypertrophy is unassociated—primarily at least—with disease of the bladder.

Much of the obscurity of origin of prostatic hypertrophy is probably due to the clinical fact that the primary condition which precedes true hypertrophy is rather exceptionally brought to the attention of the surgeon. A certain amount of diffuse hyperplasia from prolonged hyperæmia incidental to various causes of irritation in all probability exists in many men under middle age. It is not, however, until distinct hypertrophy or hyperplasia has occurred that definite symptoms are complained of. In fatal cases the process is so far advanced as to bear very little resemblance to the chronic engorgement and simple hyperplasia which constituted the initial stage in the so-called hypertrophic process. Concerning Thompson's views in regard to inflammation or circulatory disturbance as factors in the etiology of prostatic hypertrophy, this much may be said, viz., Chronic

congestion and inflammation do not produce true hypertrophy it is true, but they do produce hyperplasia, especially where the circulation is impeded by the relatively dependent position of the part. The hyperactivity of the part induced by the resulting irritation will explain the true hypertrophic element of the disease, which as a matter of fact is subordinate to the hyperplasia. This argument is especially true as applied to the prostate, which is a glandulo-muscular organ.

Racial peculiarities seem to have a marked influence in the etiology of hypertrophy of the prostate. It is met with in the negro but rarely. Dr. Hunter McGuire, states that he has never found an example of it in the pure-blooded negro, but has seen several instances of it in mulattoes. Other surgeons in the Southern States have met with the disease in pure bloods.

The causes of the disease, according to the views of the author, may be classified as follows:

General causes....	Senility. The gouty or rheumatic diathesis. General atheroma.
Local causes.	Chronic irritation and hyperæmia due to urethral or bladder disease. Masturbation. Sexual excesses. Prolonged and ungratified sexual excitement.

It is obvious that the local and general etiological factors are most effective when associated. It is true that these causes are not recognized by most modern authorities, yet in my opinion such etiological deductions are based upon sound physiological reasoning, taking into consideration the structure and function of the organ. The prostate is one of the most important organs associated with the sexual function. It is particularly important from the fact that it is the seat of sexual sensibility and is intimately involved with the venereal orgasm. One of the most important elements in the sexual act is active hyperæmia of the prostate, and it seems plausible from this fact alone that excessive sexual indulgence may produce permanent injury to the organ. Should sexual excesses be alternated with prolonged and ungratified sexual desire, a permanent impression will be still more likely to result. Constant over-stimulation of the glandular tissues of the prostate is a very important element for consideration.

The enlargement of the prostate produced by chronic hyperæmia is usually of no particular importance, from a mechanical standpoint, during the youth or early adult life of the individual. This is prob-

ably explicable by the relief afforded by free secretions, by the elasticity of the tissues themselves, and by the fact that the bladder retains its normal tonus for some time. When, however, the individual passes the prime of life and his tissues become less resilient and secretion in general less active, if the hyperæmia continues, there is less secretion and a diminished activity of the return circulation, with consequently less relief of the condition of relative hyperæmia.

Few authorities at the present day attribute as much importance to prolonged irritation and habitual engorgement of the prostate from various causes as did the elder Gross, but it is the author's opinion that the etiological factors outlined by this distinguished surgeon were based upon sound reasoning and accurate clinical observation. Any condition of the urethra which gives rise to prostatic irritation and hyperæmia or to actual inflammation, may lead to permanent irritability of the vesical neck, with a resulting increase in the frequency of urination which may become a permanent condition. It seems reasonable that such a condition may produce, later in life, hypertrophy of the overworked prostate when, as is likely to be the case, undue sexual excitement or indulgence coexists with the urinary irritation. The gouty and rheumatic diatheses probably bear a subordinate relation to the etiology of hypertrophy of the prostate in certain cases.

In a general way, it may be said that the various etiological factors outlined are productive of prostatic overstrain, which bears the same relation to prostatic hypertrophy that a long-forgotten strain, experienced during early life, sometimes does to a stiffened and thickened joint in the aged. It is a matter of common experience that when an individual well along in years begins to lose that elasticity which characterized his tissues in youth, when his joints begin to grow less mobile and he is inclined to rheumatoid and other senile difficulties, special complaint is likely to be made of so-called rheumatism or rheumatoid arthritis limited to some joint which has experienced an injury at some remote period. Many injuries experienced in youth, and long forgotten, are called to mind by some pathological change supposed to be incident to senility. It is hardly conceivable that so large a proportion of mankind should be affected with prostatic hypertrophy if there were no special causes for the condition such as those above-mentioned. Prostatic hypertrophy is certainly not a natural concomitant of advanced life, and it is probable that the various causes which have been mentioned bear the same relation to it that frequent child-bearing does to certain pathological conditions of the uterus. It is a noteworthy fact that the majority of authorities who do not frankly acknowledge that they are unable to

assign the disease to any particular cause, dwell with greater or less emphasis on the dependence of the disease upon conditions which produce irritation and hyperæmia of the organ. It is also worthy of note that the operation of castration recently advocated for enlarged prostate, has in several cases been beneficial. This has a direct bearing upon the etiological views above outlined.

Prostatic enlargement, as shown in the *résumé* of opinions upon its etiology, has been attributed to stricture. Stricture of the urethra is undoubtedly capable of producing chronic congestion and hyperplasia of the prostate—*i.e.*, overstrain with resulting circulatory disturbance. Paradoxical as it may seem, however, the danger of resulting prostatic hypertrophy is inversely to the degree of obstruction. Strictures of large calibre in the penile portion of the canal produce proportionately greater reflex disturbance of the prostate than deep strictures of small calibre. A man who at the age of from thirty to forty develops a tight stricture in the deep urethra is likely to be perfectly protected from enlarged prostate in after-life. Irritation and congestion of the prostate occur, it is true, but hyperplasia of that portion of the organ which is most likely to produce urinary obstruction is prevented by the pressure of the urine in the prostatic urethra during micturition. The author's experience in the performance of perineal section upon tight strictures in the musculomembranous region is that the prostatic urethra is often dilated, apparently at the expense of the prostate itself, or at least that portion immediately contiguous to the mucous membrane lining the prostatic urethra. The effects of pressure in producing relative prostatic atrophy are well shown in cases of calculi which become lodged in the prostatic urethra. There may be, it is true, compensatory hypertrophy of the remaining fibres of the prostate, but we must not forget what seems to be a logical analogy, viz., the hypertrophy of the heart followed by extreme dilatation which results from obstructive valvular lesions.

Varieties.

Hypertrophy of the prostate presents itself in several different forms, depending mainly upon the arrangement of the elements composing the abnormal growth. It is occasionally associated with atheromatous degeneration and thickening of the walls of the bladder, the prostate being diffusely enlarged and the anatomical characters of the bladder changes and prostatic overgrowth being approximately the same. In a general way, the varieties are as follows:

1. Diffuse enlargement of the gland associated with atheroma of the bladder. Exceptionally, circumscribed development of the pos-

terior median or one of the other lateral lobes may be associated with vesical atheroma. As a rule, however, where vesical atheroma is found, the prostate is uniformly enlarged. In this variety the thickening of the bladder, especially that portion immediately contiguous to the prostate, is likely to be considerable, the vasa deferentia, seminal vesicles and possibly the ureters, participating in the atheromatous process, the connective tissue enveloping these structures being greatly thickened by the atheromatous deposit, producing a gristly or semi-cartilaginous condition of the tissues. Rigid columns of atheromatous tissue are likely to project into the bladder. In some instances columns of this sort correspond to the course of the ureters and vasa deferentia. A bar between the ureteral orifices is common in this condition.

2. Diffuse enlargement without atheroma of the bladder.

3. Hypertrophy of both lateral lobes, the median portion of the prostate remaining comparatively normal.

4. Hypertrophy of both lateral lobes associated with posterior median hypertrophy, so-called hypertrophy of the middle lobe.

5. Hypertrophy of one lateral lobe associated with posterior median hypertrophy.

6. Posterior median hypertrophy with little or no enlargement of the rest of the organ. The overgrowth may present a quite acute prominence in the median line or may be more or less irregular, filling up the vesico-urethral orifice and projecting to one or the other side.

7. Hypertrophy of the anterior portion of the prostatic floor. This may or may not be associated with hypertrophy of one or both lateral lobes. The latter is most frequent.

8. Some form of prostatic hypertrophy associated with bar at the neck of the bladder.

9. Distinct circumscribed fibro-adenomatous tumors occurring in some part of the gland. These are somewhat analogous to the fibromyomatous neoplasms which develop in the uterus. When these new growths occur in the floor of the prostatic urethra they may form quite distinct pedunculated tumors. In some instances they project from the posterior median portion into the bladder and act after the manner of a ball valve in producing urinary obstruction.

When the prostate is diffusely enlarged the mass may not cause so much difficulty, even when it is very large, as is produced by irregular development associated with deviation of the prostatic urethra and obstruction of the vesical neck. It seems that it is not the degree but the variety of enlargement which is most important. A very large gland may sometimes be tolerated, while a very small median obstruction often gives rise to great annoyance. It is prob-

able that in many cases of prostatic hypertrophy the process is at the beginning of an adenomatous character, affecting the glandular structures of the organ. As the process advances fibro-sclerotic changes develop and eventually the enlargement appears in the form of a fibro-adenomatous development. In all the varieties of prostatic hypertrophy it is probable that there is not only hypertrophy of the elements of the organ but a true hyperplasia, which primarily at least is the predominating condition. It is a serious question as to whether the process should not be termed hyperplasia rather than hypertrophy of the prostate. Certainly the increase in bulk is due more especially to an increase of the normal tissue elements rather than to an exaggerated development.

The most frequent variety of prostatic enlargement is that in which, with or without enlargement of the lateral lobes, posterior median hypertrophy exists forming the so-called middle lobe. This form of hypertrophy is also the most important because of the fact that a comparatively slight overgrowth in this situation produces an amount of mechanical obstruction and irritation of the vesical neck which is greatly disproportionate to the degree of the enlargement. The form of median hypertrophy varies considerably. In some cases a distinct fibro-adenomatous overgrowth of pedunculated form is met with. This, as already suggested, is likely to have a valve-like action producing intermittence of the stream of urine during micturition, with perhaps more or less spasmodic action of the part about the neck of the bladder which is strongly suggestive of vesical calculus. Cases presenting this form of hypertrophy are, other things being equal, quite amenable to surgical interference, inasmuch as the necessary operation is very simple, and if it be performed at an early period before the kidneys are extensively diseased, the result is likely to be excellent. Whether pedunculated or not, the overgrowth in posterior median hypertrophy projects backward and upward, producing serious mechanical disturbances at the neck of the bladder.

Some theorizing has been done upon the causes of the transformation of posterior median overgrowths into polypoid tumors. It has been asserted that the mechanical squeezing to which the part is subjected during frequent, painful, and more or less spasmodic efforts at micturition is responsible for the jutting out and eventual pedunculation of the growth. It seems reasonable to suppose that in certain instances such an explanation is logical, especially where the point of departure of hypertrophy is thoroughly circumscribed in the posterior median portion of the organ.

The term median lobe is an unfortunate one, as it is apt to lead to

the supposition that a third or middle lobe exists in the normal prostate, when, as a matter of fact, the projecting growth is invariably a pathological formation, being due primarily in all probability to a peculiar circumscribed hyperplasia of that portion of the organ constituting the posterior portion of the floor of the prostatic urethra. This portion of the organ is quite important in its relations to the sexual function, and it is possible that the frequent limitation of prostatic hypertrophy to this region is a point in evidence of the causal relation of aberrations of sexual physiology to the disease. In a general way, whatever the form of hypertrophy may be, it produces its most serious effects by mechanically obstructing the outflow of urine. Marked secondary changes in the floor of the bladder are chiefly dependent upon this mechanical obstruction. The pouching of the vesical walls in the vicinity of the trigone, known as the *bas fond* or lower bottom, depends for its formation chiefly upon the intravesical pressure incidental to mechanical obstruction of the vesical neck.

As classified by Thompson, there are four varieties of hypertrophy according to the relative degree of involvement of the several structures of which the prostate is composed, viz.: (1) Simple increase in the development of all the component tissues of the organ in about equal ratio. (2) Excess of development of the stromatous and fibrous structures—*i.e.*, pale muscular fibre, connective tissue and elastic tissue—over the glandular portion. (3) Excess of development in the glandular portion—*i.e.*, basement membrane, follicles, excretory ducts, and epithelium—over the stromatous. (4) Rearrangement of the structures, stromatous and glandular, in the form of a tumor—circumscribed or localized development. Of these varieties the second or stromatous variety is the most frequent. It is stated by Thompson that of 70 specimens of hypertrophied prostate in the Museum of the Royal College of Surgeons, in 17 there were isolated tumors which were clearly discernible. These tumors he divides into (1) those embedded in the substance of the organ, but the structure of which is isolated from that surrounding them, and (2) outgrowths or tumors which are continuous in structure with the portion of the prostate from which they spring, but which manifest a tendency to become partially isolated by assuming a more or less polypoid form and maintaining attachment to the parent body through the medium of a pedicle only.

Some cases of isolated tumor approximate very closely in their structure, myo-fibroma. Indeed, Rokitansky formerly considered these tumors to be simple fibrous formations similar to fibroids occurring in other portions of the body. Upon careful examination they are usually—according to some authorities, always—found

to be of a structure quite similar to that of the remainder of the organ, *i.e.*, of a fibro-adenomatous character with but little muscular tissue. They may, however, be completely isolated by a true fibrous capsule from which they may be readily shelled out. It is not unusual to find circumscribed posterior median growths which are covered apparently only by vesical mucous membrane, and which are readily shelled out with the finger after incision of the overlying tissues. In a recent operation, the author removed a growth of this kind with the index finger with very little force and without any preliminary cutting whatever. These growths resemble adenoma rather than fibro-myoma.

Bar at the Vesical Neck.—There occurs in some cases, as a consequence of hypertrophy of the prostate, what was called by Guthrie "bar at the neck of the bladder." The classical form may occur independently of prostatic hypertrophy, from enlargement of the muscular fibres which run across the trigonum vesicæ just behind the prostate. As a consequence of this enlargement the bundle of muscular fibres projects from the floor of the bladder so as to produce decided obstruction to the flow of urine. Prostatic hypertrophy proper produces bar at the neck of the bladder in two ways. In the first instance, the hypertrophy of the prostatic tissue is circumscribed, runs transversely across the floor of the prostatic sinus, and does not form a definite tumor. The other method of formation is by the projection of two portions (lobes) of the hypertrophied prostate, in such a manner that the mucous membrane is stretched across the neck of the bladder between them. In some cases the bar is seemingly due to a general atheroma of the bladder and is associated with columnar formation of hyperplastic tissue in the course of the ureters. The author has seen one specimen of bar in a subject thirty-two years of age.

Dimensions.

The size of the hypertrophied prostate varies considerably. Thompson records a case in which the transverse diameter exceeded four and one-half inches, the weight of this tumor being about twelve ounces. He says, however, that such a size is rarely attained, although a diameter of three inches is not uncommon. As a rule the enlargement is rather moderate. Considerable enlargement may exist, if the organ be uniformly involved, without producing any very marked symptoms. A relatively small enlargement of the so-called median lobe is, however, sufficient to produce considerable annoyance.

Frequency.

According to Thompson, it has been found that (1) "enlargement of the prostate in a moderate degree occurs in one out of every three individuals at middle age." (2) Thirty per cent of men above fifty years of age have 'fibrous tumors' of the prostate. (3) After the age of fifty one man in every eight has marked enlargement, but exceptionally before the age of sixty; (4) The disease rarely begins later than seventy years of age."

Morbid Anatomy.

On dissection the hypertrophied prostate is usually found to be hard and indurated as compared with the normal consistency of the organ. Sometimes, on the other hand, although considerably enlarged, its texture is comparatively soft and loose. This is usually, however, in the early cases. The more indurated variety is often associated with atheroma. The varying forms of hypertrophy have already been noted. The most frequent variety of enlargement, from an anatomical standpoint, is that in which the structure is uniformly involved. Clinically, however, median hypertrophy is the most frequently met with because of its invariably disagreeable results. Individuals with a moderate amount of general enlargement of the prostate may live to an advanced age, without ever experiencing sufficient discomfort to compel them to seek the aid of the surgeon. As a corollary, it is obvious that in the majority of cases which present themselves to our observation, we are justified in assuming that median hypertrophy exists. The three pathological divisions of the prostate, *i.e.*, the median and two lateral lobes, may be so greatly enlarged as to form three tolerably distinct tumors jutting out from the main body of the prostate; this condition of affairs is very apt to be associated with bar at the neck of the bladder. As a consequence of the enlargement of the organ the prostatic urethra is increased in length, and its curve is exaggerated. If the enlargement is at all irregular or asymmetrical the canal is tortuous. The elasticity of the prostatic urethra is necessarily impaired in all cases. The increased length of the urethra is a most important consideration in the surgery of the part, inasmuch as it becomes necessary to adapt the curve and the method of introduction of the instruments necessary for treatment to the abnormal form of the canal. On section the organ is usually found to be quite hard, pale, and comparatively

* Reginald Harrison also states, that one-third of the male population of the world who have passed the age of fifty-five years are the subjects of prostatic hypertrophy.

bloodless. There is in most cases an evident increase of all of the elements of the organ, more especially of the muscular and fibrous stroma. This hyperplasia is, in the opinion of the author, the most important factor of the disease. As already stated, isolated tumors, simulating myomata (?) or fibro-adenomata, may be found, in some cases surrounded by a distinct capsule, and in others not so readily outlined. Prostatic concretions may be found in some instances, and if numerous they may be contained in a sort of sac produced by absorption of the tissue of the prostate, incidental to the pressure of the calculi. These calculi may be found outside the prostate proper, in the glandular tissue about the vesical neck.

The floor of the bladder behind the prostate is dilated, often thinned, sometimes thickened by atheroma forming the depression already alluded to as the *bas fond* or lower bottom. This is found in advanced cases to contain more or less fetid and ammoniacal urine mixed with mucus, pus, and triple phosphate. In many instances a definite calculus is found. The occurrence of phosphatic calculi in cases of prostatic disease is very readily explained: As a consequence of decomposition of the residual urine, more or less phosphatic material is formed; this deposits upon a mass of muco-pus secreted by the inflamed bladder or upon a blood clot, and solidifies, the process being precisely similar to the crystallization of sugar. When once a small calculus has formed it grows with considerable rapidity; it enhances the inflammation, increases the secretion of muco-pus and deposition of phosphates, and enlarges very much after the fashion of a rolling snowball, layer after layer of phosphatic material being deposited upon its surface until finally in some instances an almost incredible size is attained. The nucleus may be formed by insoluble drugs or foreign bodies introduced into the bladder, or may consist of uric acid or urates. The typical calculus of the *prostatique*, however, is phosphatic. The bladder, as a consequence of obstruction to the urinary outflow, undergoes compensatory hypertrophy, and eventually its mucous membrane becomes inflamed and presents the ordinary appearances of chronic cystitis.

The associated pathological conditions of that portion of the genito-urinary tract above the prostate naturally call for consideration under the head of the morbid anatomy of prostatic hypertrophy. It will be understood that these conditions are mainly secondary to the prostatic hypertrophy, varying in degree according to the variety and extent of the obstruction and dependent more particularly upon the presence or absence as well as the duration and severity of infection, secondary to the urinary obstruction. The mechanical disturbance produces in the first instance serious obstruction to the return

flow of blood through the veins. Vesical hyperplasia and congestion of the mucous membrane with resultant excessive formation of mucus is a natural result. In some instances the bladder becomes enormously thickened as a consequence of the frequent and forcible efforts at micturition. Interstitial proliferation of connective tissue occurs, and the bladder finally contracts down into a hard mass little resembling the normal viscus, the cavity of which may contain but a few drachms of urine. In other instances, as a consequence of attacks of retention from time to time superadded to the continual obstruction to the urinary outflow, the bladder becomes atonic, dilated, and presents a trabeculated appearance incidental to the hypertrophy of the fasciculi of muscular fibres composing its walls. The portions of the bladder walls corresponding to the interstices between these bundles of muscular fibres are relatively thinned, dilated, and perhaps sacculated, the sacculi containing decomposing urine, muco-pus, phosphates, and perhaps one or more calculi, presenting in short the same conditions as does the *bas fond* in the presence of a septic cystitis. The mechanical effect of the prostatic hypertrophy extends further than the bladder and involves the ureters and kidneys. These may be dilated and thickened. The kidney presents more or less thinning of its cortex with dilatation of its pelvis. These results occur sooner or later whether or not infection of the bladder is superadded. The disturbance of nutrition incidental to this condition of dilatation and thinning from the backward pressure of the urine affords a *locus minoris resistentiæ* which is extremely favorable to bacterial infection. The slightest degree of hyperæmia superadded to this condition may completely suspend the already more or less inhibited function of renal secretion with resulting uræmia and speedy death. Necessarily the impairment of function incidental to the chronic conditions produced by the urinary obstruction results in a greater or less degree of urinary empoisonment of the general system. The septic effects of prostatic hypertrophy are attributable directly or indirectly to bacterial infection. The congested hypersecreting mucous membrane of the bladder affords a favorable soil for bacterial infection; the mucus secreted favors chemical changes in the urine. The collection of residual urine in the *bas fond* behind the obstruction is more or less stagnant as a consequence of imperfect emptying of the bladder and very readily undergoes decomposition under favorable circumstances of bacterial infection. The conditions necessary for infection are almost invariably afforded by septic catheterization by either the patient or his physician. Consequent upon the sepsis, cystitis with ammoniacal decomposition of urine results. The infection in extreme cases travels along the ureter to

the kidney, setting up septic pyelitis and finally pyelonephritis. The process develops so gradually that the patient may tolerate it for a prolonged period. In some instances the urine when freed from the products of mucous inflammation appears so nearly normal that serious renal disease is not suspected. The degree of involvement of the kidney compatible with life is, in these cases, something extraordinary. The patient may tolerate his pyelonephritis for a prolonged period and may appear to be a favorable subject for operation. Operative shock and anæsthesia, however, precipitate acute hyperæmia of the already damaged kidney, and the patient dies, the post-mortem examination revealing the fact that but a very small proportion of cortical substance of the kidney remains, and this is so damaged that it is extraordinary that the patient should have been able to endure it for so long a time. The gradual development of the process, with a relatively slow tissue metabolism and a certain degree of acquired tolerance of urinary toxæmia is the probable explanation. The practical point which the author desires to emphasize is that serious impairment of the kidneys is inevitable in all cases of prostatic hypertrophy which produces even moderately serious obstruction to the urinary outflow, if the obstruction be allowed to continue for any great length of time. In long-standing cases in which operation is proposed, the existence of serious impairment of the structure and function of the kidneys is to be taken for granted, the condition of the urine to the contrary notwithstanding.

Symptoms.

The symptoms of prostatic hypertrophy are obviously those incidental to urinary obstruction and the various conditions secondary to, or engrafted upon it by, infection. Hypertrophy must necessarily exist in many instances for a long time before symptoms are produced. The condition is not painful *per se*, and there may be no evidence of its existence until a sufficient size has been attained to produce mechanical interference with the function of urination. In quite a proportion of cases, however, more or less marked symptoms, referable to the vesical neck, exist for some years before any appreciable degree of obstruction occurs.

As the prostate is one of the principal factors in the *coup de piston*, or the final spasmodic contraction of the urethral and cut-off muscles for the purpose of ejaculating the final drops of urine or semen from the urethra, one of the first symptoms of prostatic hypertrophy is difficulty in clearing the canal of fluid. Obviously, whether the prostate is an active participant in the process of closing the neck

of the bladder at the termination of urination or not, it must necessarily interfere with this process when it becomes rigid and enlarged, by resisting the pressure of the cut-off muscle. The individual soon notices a little tardiness in the commencement of the flow and a lack of force of the stream of urine. The explanation of this is very simple. Under normal conditions there is nothing to retard the flow of urine after the cut-off muscle has been voluntarily relaxed, the prostate being elastic and distensible. When, however, it has become rigid and inelastic it opposes the action of the detrusor urinæ muscle and inhibits in a certain degree the flow of urine. This is in itself sufficient to induce sooner or later compensatory hypertrophy of the vesical walls. The stream of urine may be a trifle smaller than normal, but, as a rule, it is not appreciably changed, a very important point in differentiating this condition from stricture of the urethra. Pouching of the bladder at the *bas fond* occurs in many cases before appreciable symptoms are manifest, and as a consequence the bladder is never entirely empty, a few drops of urine accumulating in this situation quite early in the course of the case. If bacteria enter the bladder this residuum decomposes and produces irritation and a consequent catarrhal condition of the vesical mucous membrane, with a resultant feeling that the bladder has not been entirely emptied. The author desires to emphasize the fact that it is not the residual urine *per se* that produces the irritation, it is tolerated unless infected. As the case goes on the calls to micturate become more frequent. A sense of fulness and discomfort in the perineum and rectum are experienced after a time, this symptom being aggravated during and after stool, particularly if the bowels be constipated. There may be so much irritation about the parts that the nerves of sexual sensibility are affected with the production of priapism. Instances of extreme libidinousness in old men are usually associated with hypertrophy of the prostate. In other cases impotence results.

As the case progresses the cystitis becomes more marked, the *bas fond* increases in depth with a consequent increase in the amount of residual urine, and the obstruction at the neck of the bladder becomes so marked that the organ contains quite a quantity of urine after the patient has apparently emptied it. It is sometimes a matter of surprise to the patient, especially if he consults a surgeon early in the course of the case, to find that it is possible to draw off a large quantity of urine with the catheter when he supposes that he has emptied the bladder completely.

Incontinence of urine, especially at night, is a frequent symptom. It is due to overflow of the distended bladder at a time when the tonicity of the cut-off muscle is interfered with. The normal tonicity

of this complex muscle, in combination with the volitional power of the patient, is sufficient to prevent dribbling of urine (excepting after prolonged retention) in the day-time. When, however, the volition is inhibited by sleep, overflow is quite apt to occur. Another cause for apparent incontinence at night is a reflex effort on the part of the bladder to empty itself under the stimulus of inflammation about the vesical neck. A point which has hardly received sufficient attention is the fact that when the prostate is uniformly enlarged the neck of the bladder loses its contractility, and is rendered more patulous than usual, although it may be apparently contracted on account of the loss of elasticity. The condition is very much like that which would occur from the substitution of a small but rigid and inelastic tube for a comparatively large, elastic, and contractile one. Attacks of complete retention eventually occur from time to time; these are usually superinduced by acute congestion of the prostate and vesical neck, incidental to excesses in eating, drinking, sexual indulgence, or to exposure to wet and cold, particularly under circumstances favoring chilling of the lower extremities. The pain and prostration due to retention are apt to be entirely disproportionate to the amount of urine contained in the bladder; some patients will suffer severely from the retention of a comparatively small quantity of urine, while others will passively permit the bladder to become enormously distended without sending for aid. The author recalls a case which was quite interesting as bearing upon this point. This patient was an old gentleman of seventy-five years of age who had suffered for years from enlargement of the prostate with occasional attacks of retention. On this occasion, as a consequence of slight exposure, he found himself unable to pass water, the retention being associated with the most severe pain and vesical tenesmus. He was in a condition of extreme prostration as a consequence of his suffering, but stated that he had been able to pass urine four or five hours previously. The catheter showed that the bladder did not contain more than a pint and a half of urine of a comparatively healthy appearance. Cases of this kind are due to acute hyperæmia of the prostate and vesical neck, causing these parts to become extremely hyperæsthetic. It is to be remembered in this connection that cases occasionally arise in which the bladder becomes immensely hypertrophied and contracted, so that it will contain but a few drachms of urine. Such cases, however, do not present the clinical features of the case in question, in which the bladder was very tolerant of urine as long as it was evacuated and the mucous membrane irrigated at proper intervals.

Urethral fluxes of muco-pus are occasionally seen in cases of enlarged prostate. These are due either to mechanical pressure on the

organ during stool or micturition or to coexisting anterior urethritis. In long-standing cases there may be from time to time urethral hemorrhage as a consequence of prostatic congestion. These cases are less liable to acute retention because of the conservative effect of the bleeding.

As the morbid changes increase, the patient becomes very irritable and testy; slight chilly sensations and more or less fever, particularly during the afternoon, are not unusual. The functions of the digestive organs are apt to be more or less disturbed; the general strength is somewhat impaired, sometimes early in the case. These various symptoms are due to more or less impairment of the function of the kidneys with consequent slight uræmia, in combination with a certain degree of absorption of the products of decomposition from the urinary tract. This condition may be termed chronic urinary fever.

In the early stages of enlarged prostate the urine contains more or less mucus; later on this is replaced by muco-pus in the form of little masses and clots, and an abundance of triple phosphates. Sometimes the fluid is dark from admixture with blood, particularly if calculus exists. The acidity of the urine gradually diminishes until it eventually becomes very ammoniacal and fetid.

If calculus forms in the course of the case there may be considerable pain, especially during movements involving jolting of the body, but this pain is not so marked as in cases of calculus dependent upon other causes. In ordinary cases of stone the stream of urine during micturition is apt to be suddenly checked, and coincidentally severe pain with more or less bleeding occurs during the expulsion of the last few drops of urine. In enlargement of the prostate the stone lies passively behind the obstruction at the neck of the bladder, and as the contractility of the muscular walls of the *bas fond* is impaired it is not impelled against the sensitive vesical neck at the termination of micturition.

Attacks of acute cystitis may occur from time to time in the course of hypertrophy of the prostate, and are apt to lead to a fatal result through exhaustion or perhaps gangrene of the vesical mucous membrane. Patients of a gouty or rheumatic diathesis are particularly apt to have intercurrent attacks of retention and acute inflammation.

As the foregoing symptomatology demonstrates, there is no class of patients who are more worthy of the sympathy and careful attention of the physician than the unfortunate victims of pronounced prostatic hypertrophy. It is indeed sad that such a large proportion of humanity should be afflicted with so harassing an affection during the declining years of life, at a time when there are so many other

infirmities incidental to senility to render the life of the old man uncomfortable. As a consequence of the drain upon the system produced by the discharge of pus from the bladder and depression of the nervous system from pain and loss of sleep in combination with the effects of general senile decline, the patient with enlarged prostate is apt to have his life considerably shortened, even if he escapes the dangers of acute retention, cystitis, and renal complications. The fact that the life of the patient will inevitably be made miserable is sufficient to warrant us in seeking radical measures of relief and adopting them at an early period when operation is comparatively safe and holds out a reasonable prospect for permanent benefit.

Diagnosis.

The most accurate information regarding the condition of the prostate body is to be obtained by rectal exploration with the finger. The bowels should be evacuated by means of an enema, and if the patient is very sensitive a small quantity of morphine or cocaine may be introduced by suppository a short time previous to the examination. The prostate is discernible to the expert finger even in its normal condition, but whenever it is at all prominent some condition of disease may be inferred. In certain cases of enormous enlargement of the organ the rectum is so encroached upon that the tumor can be felt immediately the finger passes the sphincter, rendering it necessary to depress the finger in order to pass it by the obstruction. By this mean of exploration the size and conformation of the prostate are very readily made out. When the median lobe is enlarged a certain degree of resistant fulness will be detected above the upper border of the body of the organ at a point where, when the prostate is normal, nothing can be felt, excepting the elastic fluctuating wall of the bladder. It is desirable to note whether the bladder is accessible beyond the border of the prostate as evidenced by marked fluctuation, especially if there exists the possible necessity of tapping the bladder through the rectum. If there is much inflammation or acute hyperæmia, the finger elicits great tenderness with rectal and vesical tenesmus. Any irregularities of the prostate which may possibly indicate tumorous outgrowths should be carefully outlined and noted.

Great assistance in exploration is afforded by a metallic catheter introduced into the bladder. The instrument and the exploring finger in the rectum are made to engage between them the structures about the neck of the bladder. In this way a very fair approximate idea of the extent of the hypertrophy and the degree of induration may be formed. By urethral exploration we may often derive con-

siderable information regarding the condition of the prostate. In a suspected case of hypertrophy the first attempt at exploration should be made with an ordinary catheter. If this passes readily without the necessity of marked depression of its handle, and if, moreover, urine flows through it when it has penetrated to the depth of seven or eight inches, the prostate is in all probability not appreciably enlarged. If, on the other hand, hypertrophy exists it will be found necessary to depress the handle of the catheter well downward toward the feet of the patient before its point will enter the bladder, and even then it may be found impossible to introduce it without the use of undue force, because of the point impinging upon the bar at the vesical neck or the median lobe, as the case may be. If we succeed in entering the bladder the urine often does not flow until the instrument has penetrated to a depth of say ten inches or more. If the ordinary catheter does not readily enter the bladder Thompson's metallic prostatic catheter, which has a longer and greater curve, should be employed. If median hypertrophy or bar exists this instrument will usually pass by the obstruction with comparatively little difficulty. When the lateral lobes are asymmetrically enlarged the point of the catheter and consequently the handle are deflected in a direction corresponding to the existing malformation of the urethra. The depth to which it is necessary to pass an instrument before the urine flows is a fair criterion of the degree of enlargement. Thompson has devised a "searcher" for exploration of the bladder, which in practised hands gives very valuable information regarding the size and form of prostatic hypertrophy, the presence of tumor or stone, and the depth of the *bas fond*.

It will be found best in the majority of cases to examine the patient in the dorsal decubitus with the knees and thighs flexed and separated. In rectal examination of the prostate, however, the writer has found a posture similar to the Sims gynecological position most favorable to exploration.

The differential diagnosis of hypertrophy of the prostate requires the exclusion of stricture, vesical calculus, vesical tumors, atony, paralysis, and simple catarrh of the bladder—stricture and vesical calculus being the diseases for which it is most likely to be mistaken. Most of these conditions may usually be excluded by a careful study of the history of the case and physical examination of the size and form of the prostate and the contour and length of the urethra. The age of the patient is in all cases a most important consideration.

It is wise not to be too arbitrary in the matter of diagnosis based upon subjective symptoms; as these diseases have many symptoms in common. Very often a calculus will coexist with enlarged

prostate and be unsuspected because of the fact that, as already stated, the contractibility of the vesical walls is so impaired that the stone cannot be forced against the tender vesical neck. Rectal exploration and the passage of instruments into the bladder are necessary to complete the diagnosis in any case.

Treatment.

Until within recent years the treatment of hypertrophy of the prostate embraced only measures of palliation. Internal medication and treatment by pressure in the hope of absorbing the adventitious tissue composing the overgrowth had alike proven ineffectual. Radical methods of surgical relief were considered inapplicable. In the minds of a large percentage of the profession this same view holds at the present day. In the light of the developments of modern aseptic surgery, however, particularly in the direction of operations upon the genito-urinary tract, this old-time view should be abandoned. The author has no desire to foster a spirit of surgical hyperactivity, but he is firmly convinced that there is a wide field for judicious operative measures in the treatment of hypertrophy of the prostate. It is of course admitted that radical measures are not applicable to all cases, but it is also claimed that the results of operations by surgical routinists should by no means be taken into consideration. In certain quarters it is held that surgical intervention is not to be thought of until the patient is in such a desperately bad condition that operative measures afford very little prospect of success. The surgery of the prostate has never been given a fair opportunity for development. The cases which are submitted for operation are usually those in which all other measures of treatment have not only failed but complicating conditions have arisen which seriously enhance the dangers of operation. Operative statistics based upon the results obtained in the class of patients upon whom we at present have the most frequent opportunities of operating are practically worthless excepting in so far as they bear upon the radical cure or recovery from the operation in a particular class of desperate cases. With a proper understanding of the limitations and indications of the operation and a judicious selection of cases there is no reason why early operations upon the prostate should not yield excellent results. In the opinion of the author, radical operations upon the prostate would be comparatively safe if performed prior to the development of septic complications or renal disease—*i.e.*, if performed at a comparatively early period after the development of the urinary obstruction. A fairly good prospect of success, sufficiently good to warrant operative interference, exists

even after vesical complications have arisen, providing the kidneys have retained their structural and functional integrity. Inasmuch as mechanical obstruction and sepsis sooner or later cause serious vesical and renal conditions in by far the majority of *prostatiques*, it is evident that operation should be done much earlier than is usual. In a work designed for medical men rather than surgeons elaborate descriptions of operations would be out of place. Some general considerations, however, may be of value.

From an operative standpoint cases may be divided for consideration into:

(*a*) Incipient cases in men of moderately advanced age with comparatively healthy bladder and kidneys.

(*b*) Advanced cases in patients of otherwise rugged health in whom the renal function appears to be properly performed, the bladder not being seriously involved, but in whom there is a progressive increase of urinary obstruction.

(*c*) Marked cases in subjects of advanced age in whom serious renal and bladder complications exist, but in whom palliative measures are successful.

(*d*) Advanced cases irrespective of the age of the patient in whom serious complications exist, but palliative measures are of no avail.

(*e*) Cases complicated by vesical calculus.

In class "*a*" we have to deal with men of middle age or beyond it in whom symptoms of urinary irritation and obstruction have just begun. Measures of palliation, with strict attention to the rules of genito-urinary hygiene and the occasional passage of the steel sound, may allay the irritability of the vesical neck and either greatly retard the advance of the hypertrophic process or practically prevent it. In some instances these measures of palliation are so signally successful that operation is not to be thought of. Where this is not the case, however, or where after moderately successful palliation for a period of months or years the urinary obstruction and irritation increase or attacks of retention come on, surgical interference is justifiable and should be performed before serious vesical and renal complications have time to develop, and while the constitution of the patient remains practically unimpaired by vesical irritation, chronic urinary fever, loss of sleep, etc.

The patients included in class "*b*" are naturally the legitimate successors of class "*a*." The same indications for operation prevail.

Class "*c*" comprises the cases *par excellence* in which nothing but palliative measures should be considered. Fortunately they comprise quite a proportion of cases of enlarged prostate, and while in some of them operation might have been justified at an early period, it cer-

tainly is not so at a more advanced period of life as long as measures of palliation keep the patient perfectly comfortable.

In class "*d*" are embraced patients in whom the only hope of prolongation of life and relief of symptoms is in operative measures, the character of which is to be determined largely by the local conditions found at the time of operation.

In class "*e*" there is to the mind of the author but one indication, viz., suprapubic section with or without operation upon the prostate proper, and invariably with prolonged subsequent drainage. The question of operation upon these patients is determined by the existence of the calculus, but modified by the same considerations regarding complications and the strength of the patient, as in cases in which calculus does not exist. It is true that brilliant results are reported from the operation of litholapaxy in *prostatiques*. It nevertheless seems to the author less rational and more dangerous upon the average than suprapubic section and drainage, especially if the operation be done in two stages.

The operative measures indicated in hypertrophy of the prostate range in severity from simple suprapubic section and drainage to removal of the hypertrophic tissue, the selection of operation being dependent upon the variety of hypertrophy present, the condition of the bladder and kidneys, and the degree to which the strength of the patient has been undermined by the disease. Simple suprapubic section and drainage is alone to be thought of in quite a proportion of advanced cases with serious complications. A permanent artificial suprapubic urethra is the only measure of relief for these cases. The anæsthesia is the feature of the operation most to be dreaded, and where practicable it is advisable to perform the operation in two stages, both being done under cocaine. Should distinctly circumscribed posterior prostatic tumors exist they should be removed. For this, general anæsthesia is required, and as a rule chloroform is the anæsthetic to be preferred. It is sometimes possible to remove a pedunculated growth with the finger alone. In these advanced cases, however, it is advisable not to perform cutting or tearing operations about the vesical neck. It should be remembered that in these cases a high degree of vesical sepsis exists, and the slightest abrasion of the interior of the bladder is quite a serious matter. In some instances it is advisable to defer all operative measures at the vesical neck, either permanently or until such time as the bladder and general condition of the patient has improved under the influence of vesical drainage and irrigation. Should prostatotomy or prostatectomy, however, be decided on, through-and-through drainage should be instituted. A perineal *boutonnière* does not greatly complicate

the operation, and is quickly performed, the added security afforded the patient being a sufficient warrant for its performance. In younger subjects, linear prostatotomy, or prostatectomy with through-and-through drainage may be undertaken with a much better prospect of cure than in the cases just described.

The most recent operation for the relief of enlarged prostate, castration, seems to be meeting with some success. The author has had no experience with it, but it is worth consideration providing the patient's virility has disappeared, otherwise it is better to construct an artificial suprapubic urethra, with or without operation on the prostate proper. Castration is an operation not to be lightly undertaken, as certain historical medico-legal cases have shown. Should future experience demonstrate that it is frequently successful, the surgeon should still exercise the greatest circumspection in the performance of this operation. A patient who appears perfectly reconciled to the loss of his testes may subsequently look at the matter in a different light. There is a suggestion of grim humor in the new procedure; the oöphorectomy craze of the recent past is still a vivid recollection.

The indications for any particular operations upon the prostate proper are governed entirely by the variety and form of the prostatic hypertrophy. It is obvious that in quite a proportion of cases of prostatic hypertrophy, the treatment must devolve upon the general practitioner and consist of measures of palliation. The author desires to impress upon the practitioner, however, the fact that the cases in which palliative measures should be selected and relied upon throughout are to be determined only by careful study. Palliative treatment, as a matter of routine, should no longer be accepted as the inevitable in prostatic hypertrophy, excepting under circumstances in which it is impracticable to place the patient under suitable conditions or in proper hands for operative measures. The palliative measures of treatment necessarily have a more important practical interest to the general practitioner than to the genito-urinary specialist. The function of the latter is often that of a consultant only, the management of the case, if operative measures are not advocated, being subsequently relegated to the family practitioner. Comparatively few cases of such prolonged duration as are those of enlarged prostate remain throughout under the care of a surgical specialist. It is to be remembered that the primary source of discomfort in incipient cases, is irritation of the vesical neck incidental to the hyperæmia and resulting hyperplasia of the prostate and its environs. Hyperacidity of the urine and the gouty or rheumatic diathesis are also likely to exist. Proper measures of treatment to correct the diathetic condition and remedies calculated to correct the irritating properties of the

urine are always of service. Anaphrodisiac remedies are also frequently beneficial. The remedies which have proven most serviceable in allaying vesical irritability are, buchu, triticum repens, sandalwood oil, copaiva, ustilago maidis, uva ursi, ulmus, and some others of a similar character. No one of these various remedies may be said to be equally satisfactory in all cases. It is very often necessary to do some experimentation in order to determine which remedy is most efficacious in a particular case. Bromide of potassium and ergot in full doses combined with gelsemium has seemed to be of especial value in the experience of the author. This combination not only has a special effect upon the involuntary fibre and vascular supply of the prostate but also a special action upon hypersexual activity, which probably has much to do with the causation of many cases. The occasional passage of the sound and catheter, usually advised even in incipient cases for the purpose of withdrawing residual urine, is beneficial. In incipient cases, however, the benefit is derived, not from the withdrawal of residual urine, which, if it be not infected, has little or no influence upon the irritation present, but by allaying hyperæsthesia of the prostatic urethra.

The general treatment is of great importance in all cases of prostatic hypertrophy. Temperate habits and dietetic abstemiousness are essential. If the gouty or rheumatic diathesis exists the usual preparations of colchicum, lithia, and the salicylates are indicated. Alkaline diluents, mineral waters, or pure distilled water in large quantities are of service in rendering the urine bland and unirritating. Certain remedies have an excellent effect in preventing or correcting decomposition of the urine, by their inhibiting or destructive effect upon the bacteria which bear so important a relation to the chronic cystitis present in advanced cases of prostatic hypertrophy. The best remedy which the author has tried is the oil of eucalyptus in doses of ten minims, four times daily, preferably after meals and at bed-time. Salol and boric acid have been disappointing. Benzoate of soda, naphthol, guaiacol, and small doses of carbolic acid are sometimes beneficial. The remedies previously mentioned as having a special effect upon the vesical mucous membrane are especially indicated where cystitis exists.

Exercise in moderation is to be recommended. Horseback riding, bicycling, and all exercises involving jolting movements of the body or pressure on the perineum should be avoided, especially if a complicating calculus exists. Exposure, particularly such as involves chilling or wetting of the feet and legs, is apt to bring on acute retention of urine. Warm underclothing and protection from exposure to the weather should therefore be insisted upon.

In advanced cases it is to be remembered that the principal source of discomfort consists in the presence of decomposing residual urine in the *bas fond*. The resulting frequency of urination necessarily enhances the irritation and inflammation of the parts about the neck of the bladder. The first indication, therefore, is to prevent the retention and decomposition of residual urine. Inasmuch as the patient finds it impossible to empty his bladder, it is necessary to supplement the normal function of micturition by complete evacuation of the viscus by means of the catheter. In the incipiency of the disease a single complete evacuation of the bladder daily is often sufficient to prevent serious discomfort from the hypertrophy for an indefinite time. When the patient can afford the necessary time and expense it is best that this be done by the physician.

When it is practicable for the patient to evacuate his own bladder with the catheter, a suitable instrument should be selected for him. The only instrument with which the average patient should be entrusted is some one of the many forms of soft catheters. The best of these is the Jacques catheter, a soft and perfectly flexible rubber affair, with which the patient cannot possibly do himself injury.

In some instances this catheter is rather too flexible and it is necessary to substitute some other variety. There is a form which is of a rather more substantial consistency known as the silk catheter, and another equally serviceable, the foundation of which is Belfast linen. The writer much prefers these to any other, and they are usually perfectly safe to entrust to the patient. When there is pronounced obstruction at the neck of the bladder, such as would arise from the existence of marked median hypertrophy or a bar, Mercier's catheter *coudé*, which is also a soft instrument, but which has its end permanently bent at a slight angle or elbow, will be found more serviceable than the ordinary flexible varieties. The elbow at the end of the instrument serves to direct the point up over any barrier which may obstruct its passage into the bladder. In some instances the ordinary old style English catheter with the stylet will be found most useful to the surgeon, if certain little details in its manipulations are observed. Care should be taken to keep the catheters scrupulously clean; they should be washed out with a five-per-cent solution of carbolic acid each time they are used, and when introduced should be smeared with bichloride of mercury and vaseline, 1 in 2,000, a little cocaine being added to the ointment if the urethra and neck of the bladder be intolerant of instruments. In advanced cases it is desirable that the bladder be evacuated three or four times in the course of the twenty-four hours. In some instances it is best for the patient to depend entirely upon the catheter for the evacuation of the

urine. The bladder should be washed out daily, and in severe cases several times daily, with a warm antiseptic solution; bichloride of mercury, 1 in 20,000, carbolic acid in half-per-cent solution, and a saturated solution of boracic acid are all useful for this purpose.

The following combination is of service:

℞ Sodii biboratis..... ℥ ij.
Acidi carbolici..... ℥ ij.
Glycerini.....q.s. ad ℥ viij.
M. Sig. ℥ ss. in a quart of warm water as an irrigating fluid.

The irrigating lotion should be moderately warm, or, if it seems desirable, as hot as can be borne. There is no better apparatus for irrigation than an ordinary fountain syringe with or without a soft catheter. The fluid should be allowed to enter the bladder in a small quantity at a time, for if the inflamed bladder be distended greatly an increase of irritation will result, and perhaps pain will be produced by the operation. After each irrigation it is advisable to leave about two ounces of fluid in the bladder. When cystitis is severe the daily prolonged use of the hot sitz-bath, preferably on retiring for the night, is of service. Further expatiation upon the treatment of complicating cystitis is hardly necessary, as it has received full consideration in the chapter on diseases of the bladder.

Should retention of urine come on in the course of the case, it should be relieved as quickly as possible, as typhoid symptoms are apt to supervene rapidly in these elderly and debilitated patients. Morphine in small doses and the general hot bath will facilitate surgical measures for the relief of the retention. A soft catheter should be passed if possible, and failing in this, the ordinary gum catheter with a stylet may be used. The stylet should be curved to conform with the prostatic urethra, and care should be taken not to exert much force upon the catheter in its introduction, as the point will very often catch at the point of obstruction. Under such circumstances the instrument may often be successfully passed by pressing against it just below its point, with the index finger introduced into the rectum. The finger in this instance acts as a fulcrum, and the force employed in passing the catheter is expended against it instead of the prostatic obstruction or bar. This little manœuvre will often succeed where the introduction of an instrument would be otherwise impossible. It will be found that with this semi-flexible instrument the pressure of the finger just in front of the anus will often answer the same purpose, the handle of the catheter being depressed, simultaneously with the application of pressure to the portion occupying the deep urethra. It will be seen that in manœuvres of this kind an

accurate knowledge of the conformation of the distorted urethra is necessary. There is no danger in employing tolerably firm pressure after the surgeon becomes moderately expert in this method of procedure, providing such pressure be received upon the finger applied to the bend of the catheter in the perineum.

Another little manœuvre which will be found to be very efficacious is the following: The stylet having been given an exaggerated curve is passed into the catheter and the latter introduced into the urethra until it comes in contact with the obstruction; the point is now pressed with moderate firmness against the obstruction with the fingers of the left hand upon the handle, and the stylet is withdrawn, while the catheter is pushed steadily forward. It will be found that, as a rule, the withdrawal of the stylet will curl the point of the catheter upward and forward, in such a manner that the point of the instrument readily glides snakewise up over the obstruction and into the bladder.

When it is found to be impossible to introduce a flexible or semi-flexible instrument Thompson's silver or Gross' jointed metallic catheter may be used. In extreme cases it may be found necessary to aspirate, or in lieu of an aspirator to use a small trocar. Dieulafoy's aspirator is the best for the purpose. The operation of tapping may be repeated a number of times if necessary while waiting for the acute congestion of the parts about the neck of the bladder to subside, after which the urine either flows readily or may be evacuated by the catheter. Should a trocar be used in lieu of the aspirator, it may be passed into the bladder above the pubes, or through the rectum. In the latter event a very small curved instrument should be used, the bladder being punctured in the *trigonum vesicæ* just above the border of the prostate. Should median hypertrophy exist and fluctuation at this point be absent, rectal puncture will be impracticable. When the trocar is used, it is well to leave the cannula *in situ* until it becomes practicable to evacuate the bladder by means of the catheter.

If retention has existed for some little time, care should be taken not to evacuate the bladder completely, lest there be set up, as a consequence of removal of pressure from the already weakened vesical walls, acute inflammation and sloughing with an inevitably fatal result. It has been shown experimentally that this is due to acute bacterial infection, the resistance of the tissues having been lessened by the circulatory disturbance. Such accidents are not so rare as might be supposed.

In a day or two, after the bladder has contracted down somewhat, it is advisable to evacuate it completely at each *séance*. The writer

has in some instances emptied the bladder completely at once, but has followed its evacuation by irrigation with a warm, mild antiseptic solution, a sufficient quantity of the irrigating fluid being left in the bladder to moderately distend its walls.

It will be found that very few cases will require the aspirator if the catheter be intelligently used.

It should be remembered, in connection with the subject of retention, that after a time the urine is likely to dribble away as a consequence of overflow. This may mislead the practitioner into the belief that there is no longer any necessity for the evacuation of the bladder. Many an old man has been allowed to die unrelieved because of the ignorance of the physician on this point.

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DISEASES OF THE MALE URETHRA.

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DISEASES OF THE MALE URETHRA.

It is hardly necessary in a work of this kind to enter into an elaborate description of the anatomy and physiology of the male urethra. There are a few points, however, which are of practical interest in the clinical and pathological study of its diseases. The urethra may be described as a musculo-membranous tube extending from the meatus urinarius to the bladder. It is divided into three portions, the penile, spongy, or pendulous urethra, the membranous, and the prostatic. The two latter comprise the fixed or deep urethra. The spongy or penile urethra is about six inches in length and extends from the meatus urinarius to the opening in the triangular ligament, at which point it joins the pars membranosa. The latter is about three-fourths of an inch in length and extends from the anterior to the posterior layer of the triangular ligament; the balance of the canal is comprised in the prostatic portion, which is about one and one-fourth inches long. The meatus urinarius is the narrowest portion of the canal for the obvious purpose of better directing the outflowing semen and urine. The meatus varies considerably in size. A small meatus is not necessarily an indication for a surgical operation, but when a small-calibred orifice is associated with urethral disease or possible reflex disturbance of the genito-urinary tract, a congenital contraction of the meatus at once assumes surgical importance. The meatus is sometimes narrowed because of the comparatively great thickness of that portion of the glans forming the floor of the fossa navicularis, the latter being the relatively dilated portion of the urethra, situated within the boundaries of the glans penis and terminating at the junction of the latter with the corpora cavernosa. In other cases the relative narrowness of the meatus is due to a thin membranous fold at the inferior commissure of the orifice. This is dilatable and offers little or no resistance to instrumentation, the contrary being true of the variety of narrowing previously mentioned. Narrowness of the meatus is usually congenital, destructive ulceration being the usual cause of acquired contraction. In some instances the canal is relatively narrow because of the presence of a congenital band just within the meatus, the orifice proper being fairly dilatable.

The spongy urethra is so-called because of its investment by the corpus spongiosum. The mucous membrane of this portion of the canal is abundantly supplied with mucous glands and ducts. These when infected are likely to become dilated and their orifices more or less obstructed with a resultant accumulation of infectious products in the glandular tissue proper. Latent infection and successive auto-inoculations with gonorrhœa are often thereby explained. As is well known, these ducts and follicles may be so dilated that they catch the points of instruments employed in exploration of the urethra. They may also be the starting-point of urinary abscess and fistula. Their abundance and the difficulty of rendering them aseptic is a logical explanation of the obstinacy of some cases of urethritis.

The membranous portion of the canal is invested by relatively powerful layers of longitudinal and circular muscular fibres, the compressor urethræ and accelerator urinæ muscles. On this account it has been sometimes termed the muscular portion. The function of the muscular structures of the urethra is very important. That of the membranous urethra constitutes the true sphincter of the bladder. This muscular tissue is under the volitional control of the patient, but in rather a peculiar fashion. It would seem that the sympathetic nerve fibres supplied to the muscle are responsible for its normal tonicity. Voluntary nerve fibres supplied to the part enable the patient to inhibit the normal contraction at will, as a consequence of which the steady pressure or normal tonus of the detrusor urinæ muscle is enabled to overcome the slight remaining resistance of the true vesical sphincter, with resulting voluntary micturition. Direct or reflex excitation of this portion of the canal is likely to result in retention of urine. Conversely, paralysis of the pars membranosa produces urinary incontinence.

The prostatic portion of the urethra has received attention in connection with the anatomy of the prostate. The principal diseases of this part of the canal have also received consideration as prostatic rather than urethral affections. While the urethra is under normal circumstances a urinary organ, it is by no means necessary to the function of micturition. It is, however, quite necessary to the procreative act. The urethra is, therefore, a sexual rather than a urinary organ.

The length of the urethra as given by most anatomists is from eight to nine inches, but the greatest discrepancy exists upon this particular point. A table showing the estimates of various clinical observers would show a marked variance of opinion. A difference of from twenty to thirty per cent. in the estimated measurements of equally competent observers is not unusual, and is hardly to be won-

dered at. It is probable that no two observers can possibly obtain precisely similar conditions for measurement. The penis varies in size not only intrinsically in different subjects, but there is the greatest imaginable variation in the same subject under different psychological conditions. The same conditions affect the calibre of the canal.

The individual urethra is a law unto itself as far as its length is concerned. The length of a particular urethra may be said to be the distance from the meatus traversed by the catheter before the urine begins to flow, the penis being flaccid and placed upon a degree of tension merely sufficient to afford adequate support during instrumentation. Due allowance should be made for sexual excitation or emotional inhibition.

The anterior curve of the urethra is not of great importance with relation to instrumentation, as it can be adapted to almost any form of instrument. It is different, however, with the posterior or deep curve, which is relatively fixed; it cannot be said to be constantly fixed, for, as is well known, straight instruments can be introduced into the bladder. The fixed urethral curve is not uniform, but varies widely with the period of life and the condition of the prostate body. It is comparatively short and sharp in the child, much longer and less abrupt in the adult, these characteristics greatly increasing in prominence as the subject grows older. In prostatic enlargements the curve becomes so greatly elongated as to necessitate considerable modification of instruments and in manipulations for entering the bladder. This point is of the greatest practical importance to the genito-urinary surgeon. The direction and conformation of the pendulous urethra may be modified by changes in the position of the penis. It may also be adapted to any form of instrument necessary for urethral or bladder manipulation.

The average normal curve as established by Bell, and verified by Thompson, Van Buren, and others, corresponds to a circle three and one-fourth inches in diameter, the proper length of curve for adaptation to the deep urethra being an arc of such a circle subtended by a chord two and three-fourths inches in length. The length of curve, as outlined by Thompson, is generally too long for instruments. The shorter the beak of the sound—providing it be adapted to the normal curve—the more thoroughly under control will the instrument be during instrumentation.

INJURIES OF THE URETHRA.

The subject of urethral traumatisms is strictly surgical, yet the general practitioner is quite often called upon to treat this class of

injuries. A knowledge of the proper method of management of traumatisms of the urinary canal is of the greatest importance, not only because of the immediate gravity of many cases, but because of the more remote yet serious results which may follow apparently trivial injuries.

The urethra may be contused, lacerated, or cut either from internal or external violence. Internal injuries are generally the result of surgical interference with the canal; occasionally, however, the patient wounds his urethra by the introduction of foreign bodies of various kinds. The penile urethra is only exceptionally injured by external violence on account of its extreme mobility. The deep urethra is frequently injured by falls or blows upon the perineum, the bulbomembranous region being caught between the impinging body and the sharp lower border of the subpubic ligament. A slight blow in this region may produce serious injury.

The urethra is occasionally cut or lacerated from external blows with sharp instruments.

Possible results of urethral traumatism.
- Hemorrhage.
- Retention of urine.
- Extravasation of urine.
- False passages.
- Urethritis.
- Pus infection and abscess.
- Urinary fistula.
- Permanent curvature of the penis.
- Stricture of the most intractable form.

Treatment.

In slight injuries of the urethra, the practitioner must have in view the danger of subsequent stricture. This may be averted by systematic sounding during the healing of the wound. Hemorrhage may be controlled by pressure, the ice-bag, or the retained catheter. If the injury be at all extensive and a catheter can be readily passed, it should be retained in the bladder for a few days, after which the danger of extravasation will have subsided. Systematic dilatation should now be substituted for the retained catheter. If the penile urethra be extensively lacerated, a perineal puncture should be made for vesical drainage and the lacerated tissues should be stitched in layers over a soft catheter or a piece of rubber tubing. The perineal tube may be removed at the end of a week. Primary union may be expected from this procedure.

In all urethral injuries great care should be taken in passing instruments lest the lacerated tissues be torn up and a false passage thereby made.

In deep urethral injuries a catheter should be carefully passed

and retained for a week or more, after which dilatation should be begun. If great difficulty be experienced in passing the catheter, or if the injury be severe, perineal section is indicated. If it be possible to suture any portion of the divided urethra, this procedure is advisable. The author is of the opinion that perineal section is by far the safest method of treatment for the majority of cases of injury to the perineal portion of the urethra. Should extravasation of urine be suspected perineal section is imperatively necessary.

In the management of all cases of urethral injury, the strictest attention should be paid to asepsis and antisepsis. The most important practical point in connection with urethral traumatism is the fact that stricture of the canal often follows injuries which are so trivial as to attract little or no attention at the time of their infliction. Careful attention may obviate this untoward result.

FOREIGN BODIES IN THE URETHRA.

Numerous substances have been introduced into the urethra by masturbators and by individuals who are possessed of more curiosity than good sense. Fragments of catheters and other surgical instruments are occasionally broken off in the urethra.

Possible results.
- Retention of urine.
- Urethritis.
- Ulceration.
- Abscess and fistula.
- Deposition of urinary salts and resulting calculous formation.

Treatment.

Simple manipulation perhaps combined with meatotomy is often successful in removing foreign bodies from the urethra. Specially constructed urethral forceps are sometimes necessary. When these means fail, the foreign body should be pushed on into the perineal urethra, a perineal section being first made. It is well to make the perineal section before the foreign body is pushed down, unless it be of good size, for small bodies may otherwise be forced into the bladder.

URETHRITIS.

Urethritis is the most frequent disease affecting the male genito-urinary tract. It is usually contracted during sexual intercourse and is so exceptionally acquired in any other way that it has been termed the most venereal of the class of diseases to which it belongs. The most common term for urethritis is gonorrhœa. This is a mis-

nomer for several reasons: First, because it implies a discharge or morbid flow of semen; second, because it implies a disease of an unvarying type of specificity. The generic term urethritis is accurate as applied to the affection in the male, inasmuch as it not only implies an inflammation of the urethral mucous membrane, but is sufficiently comprehensive to embrace all the varying forms of the disease whatever their origin. Neisser's discovery of the gonococcus has, however, in all probability permanently fixed the generic term gonorrhœa in its application to a specific type of inflammation affecting the mucous membranes in both the male and female. If we accept the specific character of the gonococcus, a broad line of clinical differentiation is at once established in urethritis. We are still compelled to recognize, however, certain cases in which the presence or absence of the gonococcus cannot be accepted as proving or disproving the origin of the disease in any particular venereal act. This is especially true in cases in which the affected individual has indulged at more or less frequent intervals with different females, and has suffered from previous urethral infection. Under such circumstances the recent attack may have been due to the development of gonococcal auto-infection from a focus originating in some prior attack of inflammation. In other instances the patient presents himself with a non-gonococcal discharge, and we are called upon to decide as to its specificity. Here we are compelled to acknowledge that the gonococci may have been present, but have disappeared. Practically, therefore, we are often essentially in the same position as before the discovery of the gonococcus. Especially is this true from a medico-legal standpoint. The sources of error in the diagnosis of the origin of urethritis are so numerous that it is never safe to pronounce a case of urethritis to be of specific origin, whether the gonococcus be present or not, unless the affected individual can be shown to have been perfectly healthy before the development of urethritis, or to have had intercourse with a woman suffering from virulent vaginitis, or to have a history of a more or less recent attack of gonorrhœa. This caution is particularly necessary in passing an opinion in the case of a married person.

The discovery of the gonococcus has not changed the views of the author regarding the origin of gonorrhœa and its congeners. This class of affections, in common with chancroid, may still be classed as filth diseases which originate *de novo* in the female. The author believes that germ infection of one kind or another is the *fons et origo* of the majority of cases of urethritis. It is not probable, however, that the germs producing such infection are always and invariably the same. Gonorrhœa is as old as the human race, but that the

gonoccoccus was originally the result of a special act of creation seems incomprehensible. The development of the gonococcus, and indeed of all germs capable of producing urethral inflammation, has been along evolutionary lines. We cannot accept the spontaneous generation of germs of a specific type. We may, however, believe in the transformation of innocuous germs by virtue of their adaptation to environment, into germs of a specifically pathogenic character. The female generative apparatus constitutes the most favorable environment for the development of, and acquirement of pathogenic properties by, germs that could be imagined. Protection from air and light, and the presence of heat, moisture, and decomposable secretions of various kinds constitute an excellent field for bacterial evolution. Pathological discharges and exposure of the parts to sources of local irritation constitute an additional and important factor. In uncleanly women, both pathological and physiological discharges of the male are allowed to accumulate and undergo decomposition. The semen is a highly complex organic substance, the decomposition of which in all probability results in the development of toxines of a highly irritating character.

Whether or not the gonococcus be accepted as the cause of a certain specific type of urethritis, the fact remains that the environmental conditions which have been mentioned constitute the point of departure of germ evolution, the products of which are capable of producing mucous inflammation of varying grades of severity, ranging from a simple form of urethritis to the gonococcal variety of virulent inflammation. Precisely what germ is the progenitor of the gonococcus in the process of evolution would be difficult to determine, but the difference between the specific microbe and certain germs which are normally present in the urethra of the male and vagina of the female is not very great. The dissimilarity between the gonococcus and the pus microbe is not so marked as to exclude the possibility of the transformation of the one into the other under favorable circumstances of environment. That we are unable to imitate this process of evolution is not a valid argument against the theory.

Varieties.

Urethritis may be divided into:

- Acute and chronic....
  - *a.* Simple.....
    - Bacterial.
    - Toxic.
    - Chemical.
    - Traumatic.
  - *b.* Specific.....Gonococcal.

Simple Urethritis.

Predisposing Causes.—1, Diathetic conditions; 2, chronic urethral disease; 3, morbid states of the urine; 4, sexual abuses; 5, dietetic excesses and irregularities; 6, alcoholism. It is obvious that any condition of the system which gives rise to irritability of the mucous membranes predisposes to inflammation of these structures. It is possible that this argument cannot be applied with equal pertinency to all mucous membranes, but it certainly applies quite forcibly to the urethra. Especially is this true of such diathetic conditions as rheumatism and gout, in which the urine is likely to be loaded with the products of retrograde tissue metamorphosis, which products may be both mechanically and chemically irritating. Lithæmia and oxalæmia are especially potent factors in this respect, producing as they do their corresponding conditions of perturbation of the composition of the urine, viz., lithuria and oxaluria. The urine in lithæmia is not only likely to be heavy and concentrated by virtue of its disproportionate amount of solids, but the uric-acid crystals present are exceedingly irritating to the mucous membranes of the genito-urinary tract. There is no question but that lithuria is responsible for certain catarrhal conditions of the superior portion of the genito-urinary apparatus. This catarrhal condition is possibly not so manifest in the urethra, yet the mucous membrane, by virtue of the irritating properties of the urine, is in an extremely vulnerable condition. This constitutes a standing invitation to infection and sources of irritation of all kinds. Irritability of the nervous supply of various tissues, which means essentially irritability of the tissues themselves, is another important factor incidental to the gouty or rheumatic diathesis. Closely associated with the gouty diathesis are the effects of dietetic indiscretions and excesses, and indulgence in alcoholic beverages.

As is true of all organs of the body, excessive action is a predisposing cause of inflammation. In the case of the urethra sexual excesses and masturbation are the source of much mechanical disturbance, glandular hyperactivity with excessive secretion of mucus, and possibly slight traumatisms, these various factors causing a catarrhal state of the mucous membrane which affords excellent soil for microbial action, and exaggerates the results of irritation of all kinds.

By far the most important factor in the predisposing causes of simple urethritis is chronic disease of the genito-urinary tract, whatever its origin may have been. Most of the so-called cases of bastard clap or simple urethritis are due to the effects of sexual, alcoholic, or dietetic excesses upon a urethra already damaged, and in

which the products of microbial action, particularly the products of simple decomposition, are present. This must be remembered as bearing very pertinently upon cases of suspected gonorrhœa in which the virtue and probity of one or both parties to the venereal act may be brought in question.

Exciting Causes.—1, Trauma; 2, bacteria (non-specific); 3, toxins; 4, chemical irritation; 5, sexual strain. It is unnecessary to expatiate upon traumatism as a factor in the production of urethritis. It should be remembered, however, that traumatism in a perfectly healthy and approximately aseptic urethra may be followed by little or no inflammation; often, indeed, by no phenomena which can be properly characterized as urethritis. In the presence, however, of some latent condition of disease—*i.e.*, a chronic source of infection, traumatism bears a very important relation to the etiology of acute urethritis. A very pertinent illustration of the relation of traumatism to pre-existing conditions of infection of the urethra is found in the results of operations or instrumental manipulations of the canal in the presence of stricture or congested and granular patches on the urethral mucous membrane.

In considering the relation of bacterial infection to simple urethritis, it is well to remember the fact that various forms of bacteria and their products are capable of producing irritation and inflammation of mucous membranes. The pus microbe or its derivatives, and possibly the ordinary germs of decomposition, may *per se*, or by virtue of their products, produce urethritis. The author will not discuss here the relation of the bacterium coli commune to inflammations of the genito-urinary tract. It appears highly probable that the line of demarkation between the pus microbe and the colon bacillus would be very difficult to demonstrate. A point worthy of consideration is that the secretions from disease of the urethra, originally of gonococcal origin, but from which all specific characters have disappeared, (as in certain cases of chronic urethritis, folliculitis and prostatitis and in certain inflammations of the female genito-urinary tract), are capable of producing inflammation of the male urethra. That the toxins evolved by microbial action may cause urethritis is almost if not quite certain. Any chemical irritant may produce urethritis, which sometimes assumes a severe type. The well-known experiment of Swediaur with aqua ammoniæ will be remembered in this connection.

In discussing the exciting causes of simple urethritis it is necessary to correct the fallacious notion that normal secretions in the female are capable of exciting urethritis in the male. It is nothing unusual for the apology to be offered that the man has had inter-

course with the woman just before, after, or during the menstrual discharge. The inference that the menstrual discharge may produce urethritis is as old as the Bible, as will be noted by a perusal of the fifteenth chapter of Leviticus. The Jewish tradition that the female is unclean for a certain period following menstruation is probably based upon this common but erroneously applied observation. Menstrual fluid, unless decomposed or mixed with the products of bacterial evolution of one kind or another—whether the germs be autogenetic or heterogenetic is inconsequential—cannot possibly produce urethritis. Apparent contradictions are due either to the autogenesis of urethritis in a previously damaged urethra, or to the washing down of the products of an old infection from the upper portion of the female sexual tract by the outflowing menstrual secretion. The menstrual secretion has been accepted as an etiological factor in urethritis; the water-closet theory has been repudiated, but the author entertains the belief that the latter theory has at least a basis of probability, while the former is positively absurd.

The "strain" theory of the origin of urethritis is a very popular one, but is perhaps the most fallacious of all. It is probable that sexual excess alone is never productive of the disease. Sexual excess in the presence of a diseased urethra is, however, another matter and under such conditions is a very important factor among the exciting causes of urethritis. As a predisposing factor, on the other hand, it is all-important.

Gonococcal or Specific Urethritis.

Predisposing Causes.—These are precisely the same as those enumerated for simple urethritis.

Exciting Causes.—The author will not enter into a discussion of the various arguments relative to the specificity of the gonococcus. It is sufficient to say that certain types of virulent urethritis are characterized by the presence of a germ of peculiar character—the gonococcus—which microbe may be the cause or the effect of the disease. Whether it be the cause or effect, however, it has been conclusively shown that this microbe is capable of producing in a perfectly healthy mucous membrane an inflammation similar to that from which the secretion which contains it was originally derived.

Apropos of the method of contagion in gonorrhœa, it has seemed to the author that considerable illogical reasoning has been indulged in regarding the possibility of infection with gonorrhœa in an innocent manner. Syphilis insontium is well recognized, but whenever an individual presents himself with a gonorrhœa and gives a history

of unknown or innocent source of infection, the practitioner treats the history with lofty disdain and a contempt born of a profound knowledge of human nature, particularly as manifested in venereal diseases. The author unhesitatingly affirms that, other things being equal, gonorrhœa is more likely to be contracted innocently than is syphilis. The principal limitation of the application of this statement is the fact that the structures susceptible to gonorrhœa are of comparatively small area and not very readily accessible, whereas in the case of syphilis any abraded surface will serve as a port of entry for the germ disease. Granted, however, the contact of the mucous membrane with gonorrhœal virus, infection very much more readily occurs than in the case of syphilis, the latter disease requiring an abrasion as one of the essential requisites for infection. Granted that the gonorrhœa depends upon a very virulent germ, or even laying the germ theory aside for the moment and accepting the broad proposition that gonorrhœa affords a secretion which is extremely virulent, it only remains to show that facilities for the innocent conveyance of the disease are of daily occurrence in order to substantiate the proposition that gonorrhœa may possibly be frequently contracted in a perfectly innocent manner.

The water-closet theory of the origin of gonorrhœa has received much ridicule, yet the author is inclined to the belief that if logic rather than ridicule be applied to a study of the question, the theory will not appear quite so absurd. It is a practical impossibility for an individual affected with a gonorrhœa to use the public closets found in saloons and hotels without leaving more or less of the virulent discharge behind him. The meatus urinarius is dragged over the closet seat in such a manner as inevitably to deposit more or less secretion, unless the patient be much more careful than the average man. The next individual who uses the same convenience will in the majority of instances, unless extremely careful, inevitably bring his meatus urinarius in contact with the infected surface. Is it illogical to suppose that gonorrhœal infection may occasionally occur in this manner? We are entirely too fond of questioning the veracity of the patient, but ridicule is hardly a safe argument as applied to a question that can be reasoned upon quite as logically as can the subject of infection of any other kind. The author unhesitatingly affirms that this is important from a medico-legal standpoint. The man who goes upon the witness-stand and offers expert testimony to the effect that any individual might not possibly have contracted gonorrhœa in the innocent manner above described, must certainly depart from the ordinary rules of logic, and, however profound his knowledge of bacterial infection in other directions, must necessarily manifest upon

this question the densest ignorance of sound pathological and bacteriological principles. The same argument is pertinent, although perhaps not equally so, as applied to possible innocent infection of the female. The author is well aware that this statement is likely to be received with derision, but, as already stated, ridicule upon a question so open to logical reasoning as the one under consideration is hardly worthy of respect. The possible medico-legal application of the author's opinion has received due consideration, but has by no means weakened the conviction above outlined.

Accepting the gonococcus as the most definite etiological factor that has thus far been determined in virulent urethritis, it becomes necessary to consider its characteristics. During the last quarter of a century several authors have claimed to have discovered the germ or organism upon which the disease depends, but none of their views has been generally accepted by the profession. The latest aspirant to honors in the microscopical study of urethritis is Neisser, of Breslau, who in 1879 asserted that he had discovered the specific microbe of gonorrhœa, which he termed the gonococcus. Numerous European bacteriologists published confirmatory reports regarding this micro-organism, and during the last few years several American investigators have indorsed the views of Neisser. At the present time the majority of the profession have accepted the specificity of the gonococcus. The alleged specific germ has been found in the pus corpuscles. Its detection under the microscope was first made possible by certain complicated processes of staining. A little later, Drs. Wendt and Allen, of New York City, detected the bacillus in the following rather simple manner: A drop of pus is spread into a thin layer by pressing between two glass slides, and allowed to dry in the air. A drop of solution of methyl blue in anilin water is now placed upon it for a moment and washed off with a stream from a wash-bottle. A few drops of Grams' iodo-iodide liquid is then poured on and allowed to remain for several minutes; this fixes the color of micro-organisms in general. Grams' liquid is now washed off, and, while the specimen is still wet, a cover-glass is placed upon it and it is examined with an oil immersion lens. If micro-organisms resembling the gonococcus are found, they are tested by decolorization. The cover-glass is removed, and the specimen treated with absolute alcohol until the color is as completely removed as possible. The cover-glass is replaced, and the specimen examined, when all the gonococci will be found to have disappeared; all other organisms, however, which have been present will be distinctly visible.

The gonococcus, as described by Neisser, was developed from the pus corpuscle by staining with methyl-violet and dahlia. It is

located generally upon the surface of the pus-corpuscle; more rarely upon the surface of the epithelium. Sometimes it is incorporated with the corpuscle and replaces its nucleus, which disappears. The microbe is large and spherical when single; in some instances two of them unite together in a sort of biscuit-shape. They are usually found in colonies of ten to twenty or more, surrounded by a kind of mucous envelopment.

For practical purposes the simpler methods of examination of suspected fluids are best. A drop of pus, placed upon a cover-glass, may be spread into a thin layer by placing another glass upon it and sliding the two apart. One of the glasses is then thoroughly dried by passing it rapidly through the flame of a spirit-lamp. The cover-glass is now dipped in a solution of methyl blue, and the superfluous coloring matter washed off by a stream of cold water. It should now be mounted in Canada balsam. Neisser has more recently laid especial stress upon the tendency of the gonococci to arrange themselves in pairs. This, he claims, distinguishes them from the urethrococci, which are found singly or in irregular clumps. He also says that the gonococci are found in or upon the pus corpuscle, never outside of it. One important source of fallacy at once suggests itself. It is by no means improbable that the urethrococcus may undergo modification by virtue of the existence of a virulent inflammatory process, as a consequence of which it tends to arrange itself somewhat differently and to invade the pus corpuscles. This is certainly consistent with the evolutionary theory. Taken singly, the urethrococcus and gonococcus are identical in appearance.

Morbid Anatomy.

Inasmuch as the anatomical features of specific and simple urethritis differ in degree only, the morbid anatomy of the disease in general may be properly taken up at this point. The infection of urethritis is generally supposed to begin at the meatus. Milton has remarked the apparent contradiction of urethral chancre and chancroid as regards the site of inoculation. He believes that in such cases the virus is deposited at the lips of the meatus and subsequently diffuses itself until it meets with a susceptible portion of mucous membrane. It is a question whether morbid secretions may not be drawn into the urethra during coition. The author firmly believes that they may be. It would seem that a certain amount of aspiration is produced in the urethra during the venereal orgasm, sufficient at least to draw secretions from the vagina into the urethra. The alternate contraction and relaxation of the deep perineal muscles incidental to the

efforts of the urethra to clear itself of semen during the venereal act must necessarily produce a more or less marked suction at the meatus. It is the author's impression that the inflammation really begins in the fossa navicularis rather than at the meatus proper.

The extent to which the urethra is involved is variable. The inflammation is generally most marked in the anterior portion of the canal, but in the severe types almost always involves the entire canal down to the bulbo-membranous junction and in many cases extends to the posterior urethra. The entire mucous membrane of the urethra from the meatus to the bladder may be infected. In the milder forms of urethritis the pathological changes consist in a few instances of slight hyperæmia with attendant reddening and hypersecretion. In by far the majority of cases, however, there will be found chronic changes in the canal produced by a previous attack of virulent urethritis. The pathological anatomy of simple acute urethritis and that of chronic urethritis are therefore usually identical and should be described simultaneously. In simple urethritis with a chronic inflammatory foundation, the localization of the chronic inflammation, with perhaps the formation of stricture or abraded granular and congested patches, is due to several causes: (1) The most important is the relative inelasticity of the portion of the urethra involved. This produces friction during micturition with consequent localization of the inflammation at the particular point affected. (2) Dilatation and severe inflammation of mucous follicles at one or more points in the canal. (3) Injury of the canal at different points due to the introduction of instruments, the long-nozzled syringe being the most frequent cause. (4) The spontaneous or traumatic yielding of the corpus spongiosum in the course of a chordee. (5) Slight thickening of the urethra due to previous traumatism. In cases in which posterior urethral infection—prostatitis—has occurred in the course of acute gonorrhœa, more or less enlargement of the organ is found, together with a varying degree of interstitial thickening and chronic inflammation in the prostatic ducts and follicles.

In the severe forms of urethritis the principal change consists in intense hyperæmia with swelling of the mucous membrane. This is attended by a diminution in the calibre of the canal which may result in complete retention of urine. When the inflammation is at its height, there exists an infiltration of the corpus spongiosum resulting in thickening and inelasticity of that structure. Late in the history of the case this plastic infiltration either disappears entirely or, as is very frequent, localizes itself at certain points. These points are usually the posterior portion of the fossa navicularis, the lacuna magna, and the bulbo-membranous junction. Other points in the pendulous

urethra are frequently involved. It is in these situations that we are most likely to find stricture. The follicles of the urethra are found to be dilated and filled with purulent or muco-purulent secretion. Herpetic excoriations are occasionally seen. In view of the severity of the inflammation in some cases, it is singular that true ulceration does not more often occur. It is, however, very rare. The epithelium lining the urethra will be found abraded here and there in all cases in which the inflammation is of a high grade. In some instances it is almost entirely removed throughout the extent of the canal. Superficial erosions of the mucous membrane result from abrasion of the epithelium. In chronic cases the pathological factors which are most important as explaining the persistency of the disease are stricture, congested and granular patches, enlargement of the lacuna magna, dilatation and inflammation of the glands of Littré and sinuses of Morgagni, and follicular prostatitis—*i.e.*, so-called posterior urethritis.

Complications.

The danger of complications in urethritis is directly proportionate to the severity of the inflammation and the degree and frequency with which the canal is mechanically disturbed. An important factor in the etiology of complications is the amount of exercise indulged in by the patient. With reference to the etiology of complications, it is to be remembered that the gonococcus is by no means the principal factor. Gonorrhœa is a typically mixed infection, and many of the most severe complications of urethritis are in no wise dependent upon the gonococcus excepting in so far as the gonococcus may have been the original cause of the urethral inflammation.

The principal complications of urethritis are: (1) Severe chordee; (2) hemorrhage; (3) folliculitis; (4) peri-urethral phlegmon; (5) retention of urine from inflammatory or spasmodic stricture; (6) prostatitis; (7) cowperitis; (8) cystitis; (9) epididymitis and orchitis; (10) gonorrhœal rheumatism; (11) gonorrhœal ophthalmia; (12) gonorrhœal conjunctivitis; (13) bubo; (14) balanitis and balano-posthitis; (15) vegetations, and (16) lymphangitis.

Some of these various complications are worthy of special description, but an exhaustive presentation is not practicable in a work of this kind. A few general points regarding the most important of them are, however, essential.

Chordee.

Severe chordee and distinct hemorrhage are naturally associated, inasmuch as the latter depends upon traumatism inflicted in the

former condition. Chordee develops when the inflammation is at its maximum intensity, at which time the plastic exudate is most marked. It gives rise to no inconvenience excepting during erection. The pain which it produces is therefore usually experienced at night. The penis during erection may be bent like a bow, the concavity of which is directed downward, but in some instances it may be bent to one or the other side or twisted. The principal dangers of chordee are rupture and hemorrhage with subsequent severe organic stricture or perhaps abscess.

Folliculitis.

Localized and severe inflammation of the mucous follicles of the urethra is likely to occur at any time during acute urethritis, and sometimes in the subacute and chronic types. The condition manifests itself by small, tender, spherical, or oval swellings from the size of a small shot to that of a pea along the floor of the canal, especially anteriorly. The condition is due to an infection of the urethral follicles and sinuses of Morgagni, resulting in the formation of small retention cysts containing pus and mucus. They rarely lead to serious trouble, but usually discharge themselves into the urethra. They are likely, however, to be the source of recurrent urethral infection.

Peri-Urethral Phlegmon.

This is a frequent complication of urethritis. It consists of an inflammation of the cellular tissue surrounding the urethra, and is due to: (1) Minute rupture of the mucous membrane with resulting peri-urethral infection; (2) Rupture of the inflamed and infected follicle with a similar result; (3) Infection conveyed to the cellular tissue by means of the lymphatics, or by migration of pyogenic microbes; (4) Rupture and extravasation of the dilated and ulcerated urethra behind a stricture. All of these inflammatory complications imply either extension by contiguity of structure *via* the mucous ducts, or an abrasion of epithelium with a resultant absorptive surface. Phlegmonous inflammation usually leads to suppuration, but cases occur in which resolution eventually takes place. The favorite seat of this complication is in the floor of the fossa navicularis.

Retention of Urine.

Retention of urine is essentially the same in its various phases as when arising from other causes. It depends on inflammatory swelling of the mucous and submucous tissues in conjunction with deep

muscular spasm. This is the so-called congestive or inflammatory stricture, and may be precipitated by sexual or dietetic excesses or indiscretions.

Acute Prostatitis.

This has been described in connection with diseases of the prostate.

Cowperitis.

Inflammation of Cowper's glands occasionally occurs. It is due to simple extension of the inflammation to these glands, which lie upon either side of the urethra behind the bulb and between the layers of the triangular ligament. It is usually unilateral, but it may involve both sides.

Symptoms.—The symptoms are pain, swelling, throbbing, and a feeling of tension in the perineum. Early examination detects a small sensitive tumor the size of a pea; later on the perineum becomes swollen, hard, and brawny, and it is imposible to outline the inflamed gland. Swelling, reddening, and œdema of the scrotum may occur. There is likely to be considerable constitutional disturbance incidental to the close confinement of the inflammatory exudate within the triangular ligament. Suppuration usually occurs, but resolution occasionally takes place without it.

Cystitis.

True acute cystitis is a rare complication of urethritis. The epithelium of the vesical mucous membrane is singularly resistant to gonorrhœal infection. When it does become infected, it is by virtue of the mixed infection characteristic of gonorrhœa. The majority of cases in which acute gonorrhœal cystitis is diagnosed consist of acute follicular prostatitis—*i.e.*, inflammation in and about the true vesical neck. When infection of the bladder does occur, the resulting inflammation may become chronic. Extension to the ureters, renal pelvis, and even the renal structure proper may occur. Rare cases of acute general cystitis in the course of gonorrhœa have been reported. They are characterized by profound asthenia and a typhoid condition, with dry, brown tongue, delirium, and fever, and it is claimed sloughing of the vesical mucous membrane may occur in some cases.

Symptoms.—Frequent, painful, and perhaps bloody micturition. More or less tenderness of the vesical neck, as disclosed by palpation externally and per rectum. In severe general cases extreme hypogastric tenderness exists. In some severe cases the symptoms strongly resemble those of general peritonitis, the abdominal tenderness and pain being quite diffused. A certain degree of peritoneal

involvement is quite possible. Severe constitutional symptoms are not unusual. The urine is scanty, high-colored, and perhaps bloody. It contains albumin proportionate in amount to the quantity of pus and blood present. If sloughing of the mucous membrane occurs, shreds of that structure are expelled with the urine. Clots may be formed and come away with the urine during micturition, their expulsion being attended by severe pain and tenesmus.

Epididymitis and Orchitis.

Inflammation of the testicle occurring in the course of acute or chronic gonorrhœa is very frequent. Its presence is usually an indication of extension of infection to the deep urethra. Exceptions to this rule are met with; but the proposition is accurate in its general application. Like all inflammations, that of the testis may be acute, subacute, or chronic. The affection may occur at any time during the course of a gonorrhœa, and indeed at times when the patient considers himself free from the primary disease. The body of the testis is rarely affected primarily, the condition being in the majority of cases one of inflammation of the epididymis, with perhaps more or less secondary involvement of the testis proper.

The mode of infection is of considerable practical importance. Quite frequently the disease comes on within a very short time after the introduction of instruments or after the employment of other mechanical methods of treatment. Under such circumstances the inflammation of the testis is produced in one of two ways, either (1) by direct traumatism and sepsis of the mucous membrane of the deep urethra which eventually involves the ejaculatory ducts; or (2) the instrument acts as a carrier of infectious material into the deep urethra, the germs of the mixed infection and their products being, as it were, rubbed into the mouths of the ejaculatory ducts. The prostatic follicles are usually involved, although they may apparently escape for a time at least. In a general way, the existence of epididymitis may be accepted as positive evidence of infection of the prostate. It is probable that in some cases infection occurs from the deeper parts into the urethra *via* the lymphatics, without the intervention of deep urethral inflammation. As a consequence of sexual indulgence, or without known exciting cause, inflammation of the epididymis very frequently occurs. It is the impression of the author that the sexual orgasm is very often responsible for infection of the deeper parts of the urethra by virtue of the aspirating action of the deep urethral muscles during seminal emission. It appears logical to infer that infectious materials may be drawn from the anterior into

the posterior urethra during the venereal act. The rationale of this accident has been considered elsewhere. The old-time view of metastasis of the urethral inflammation would appear to be no longer tenable. It must be confessed, however, that the clinical features of epididymitis occurring in the course of acute gonorrhœa afford some support to the old-fashioned notions regarding metastatic inflammation. The subsidence of the urethral discharge and its reappearance coincidentally with improvement in the testicular inflammation constitute a very striking feature of this particular complication of gonorrhœa, and one which must have appealed very forcibly to our medical forefathers as substantiating the theory of metastasis.

Symptoms.—It is very exceptional that testicular complications occur within the first week of a gonorrhœa. As a rule, the epididymis is not involved under ten days or two weeks. Inasmuch as the inflammation gradually progresses toward the deeper parts of the urethra, this fact is readily understood. In some instances the attack is precipitated by sexual or alcoholic indulgence, or over-exertion. Very often, as already stated, the patient presents a history of instrumental interference with the deep urethra. In chronic cases the epididymis may become involved at any time, often indeed when the patient supposes himself perfectly free from urethral discharge. Its occurrence under such circumstances is positive evidence of urethral infection. Stricture of the urethra is especially apt to be complicated from time to time by attacks of epididymitis. It is likely in these chronic cases of urethral disease to assume a subacute or chronic type.

The symptoms vary with the acuteness of the disease. In the acute cases two methods of invasion are observed. (1) Those in which the patient is primarily taken with a severe pain in one or the other groin, referable to the region of the spermatic cord. Great tenderness exists in this region. Symptoms of tissue strangulation, similar to those existing in hernia, may be observed, with slight nausea and vomiting. The author has in several instances been called in to operate on strangulated hernia and found inflammation of the spermatic cord, heralding an approaching epididymitis. Whenever this condition exists, the patient may be confidently informed that within twelve to thirty-six hours inflammation of the epididymis will develop. The reason for the severity of the symptoms is a very simple one. The spermatic cord is invested by dense fascial tendinous and muscular envelopments, especially in the vicinity of the external ring. It is by no means surprising, therefore, that the sensitive cord should be more or less strangulated when it is affected by acute inflammation. It is the opinion of the author that more or less pelvic peritonitis of that portion of the peritoneum which invests the sper-

matic cord within the pelvis is a quite constant feature of cases of inflammation of the testicle in which the cord is involved in the manner described. Cases occasionally occur in which acute appendicitis is quite closely simulated. The cases in which the cord is especially involved are usually very slow in recovering. Relapses are more frequent than when the inflammation primarily affects the epididymis. (2) Cases in which the epididymis is primarily involved and the cord only secondarily and in a minor degree. The patient is likely to feel more or less tenderness and weight with a peculiar dragging sensation along the spermatic cord for a few days or few hours before the inflammation of the epididymis develops. The testis may be extremely hyperæsthetic. The tenderness increases until the inflammation is at its maximum, when the slightest touch produces extreme pain. If the case be examined before marked swelling occurs, a little swelling and tenderness limited to the epididymis and that portion of the spermatic cord immediately adjacent to the testis will be observed. As the inflammation progresses the scrotum becomes œdematous, reddened, and tender. The urethral discharge diminishes, and in many cases entirely subsides. Milton's conclusions regarding this particular symptom in epididymitis are somewhat extraordinary. He makes the assertion that marked subsidence or disappearance of the discharge is not observed in epididymitis. If this be true of Mr. Milton's cases, great allowance must be made for a variation in the phenomena presented by patients in different localities. As far as the observations of most surgeons go, this point is so well established that it is hardly open to argument. When the inflammation is well advanced more or less fluid will be found in the cavity of the tunica vaginalis—acute hydrocele. The acute symptoms persist for from five or six days to a week, and are attended by more or less febrile disturbance. In some cases there appears to be marked disturbance of digestion; the patient loses appetite; the tongue becomes heavily furred, and constipation ensues. When the cord is more or less strangulated, considerable anxiety is manifested. At the end of from five to seven days the inflammation begins to subside; tenderness diminishes and eventually disappears, but when allowed to take its own course the testicle does not return to even approximately normal size for some weeks. When suitable after-treatment is not instituted, and often in spite of the greatest after-care, permanent induration of the epididymis is likely to result. Whenever such permanent induration exists, occlusion of the lumen of the epididymis may be suspected, and when double epididymitis has occurred and the patient appears to be sterile, the old-time inflammation of the epididymis assumes a rather formidable character. Suppuration

very rarely occurs; when it does do so, it may be due either to tubercular or to purulent infection. It is worthy of note in this connection that inflammation of the epididymis is apparently due to the mixed character of the gonorrhœal infection rather than to the gonococcus *per se*.

Toxic pseudo-alkaloids have been extracted from gonorrhœal pus which, inoculated into the epididymis of dogs, have produced characteristic inflammation.

Gonorrhœal Rheumatism.

Gonorrhœal rheumatism is an important, although relatively infrequent, complication or sequela of gonorrhœa. The possibility of its occurrence is disputed by some surgeons, but the majority of authorities admit that some individuals, who are perhaps free from predisposition to ordinary rheumatic troubles, are attacked with severe pain and tenderness of one or several articulations, attended with more or less constitutional disturbance and synovial effusion, in the course of urethritis, and that in others the same process attacks various tendinous and ligamentous structures of the body. Some patients are affected with this complication with every attack of urethritis. It rarely begins during the acute stage of the affection, being most likely to occur after the disease has become chronic. The writer has known it to occur, however, within three days after the onset of the disease. Few diseases have been the source of more controversy regarding their origin than has gonorrhœal rheumatism, and as yet its pathology must be regarded as *sub judice*. It does not appear to arise as a consequence of varying atmospheric conditions, from over-exertion, nor, it is claimed, from any particular method of treatment of urethritis. The latter proposition, however, the author is inclined to question, from practical experience with the disease, especially in a case which recently came under observation, in which the rheumatic affection speedily followed successful abortive treatment. Its dependence upon purulent inflammation of the urethra is all that has so far been absolutely established, and it is by no means necessary that actual suppuration of the mucous membrane should be present in order to give rise to it. It is claimed that, inasmuch as it occurs independently of the ordinary predisposing and exciting causes of rheumatism, and is seen in only a small proportion of the subjects of urethritis, it must necessarily be the result of individual idiosyncrasy. There is probably much truth in this assertion.

The most generally accepted opinion in regard to the pathology of gonorrhœal rheumatism is that it is a mild sort of pyæmic infection, due to absorption of the products of purulent inflammation of the urethral

mucous membrane. There is hardly a doubt of the correctness of this view; still, as might be supposed, it would be difficult to positively prove it. According to Neisser and others the disease is due to secondary infection, the specific germ being said to have been found in the fluid of gonorrhœal arthritic effusions. It is well-nigh certain that some poisonous material—toxin—elaborated by the virulent germ infection of the urethral mucous membrane, is absorbed into the circulation and conveyed to the joint structures. In some individuals these tissues are extraordinarily sensitive, and as a consequence reaction occurs in the form of arthritic effusion. Whether the gonococcus or the toxins formed by the mixed infection be the exciting cause of the affection, is open to question; the author inclines to the latter cause. It is probable that pus microbes are at the bottom of those exceptional cases in which suppuration occurs, and that certain elements in the surgical treatment of gonorrhœa are primarily responsible for the absorption of infectious materials. The destructive effect exerted by strong injections and the rude introduction of instruments upon the epithelium covering the urethral mucous membrane has already been alluded to. When the mucous membrane is abraded, or, as is often the case, almost entirely removed, it is obvious that the absorption of organic poisons is greatly facilitated. Absorption probably does not occur very readily through the intact mucous membrane, even when it is severely inflamed. When once the epithelium is destroyed, however, it may easily occur. It is probable that the relative facility of absorption in certain individuals explains their susceptibility to gonorrhœal rheumatism, and the escape of others who are more fortunate. The immunity from the disease enjoyed by women is an evidence of the correctness of this view, for the only possible explanation of the rarity of the disease in the female that can be offered is that the relatively tough vagina and endometrium, and not the urethra, are the seat of the gonorrhœal inflammation, and as a consequence absorption does not readily occur. It will be found that when it does occur in the female a typically virulent and acute vaginitis has existed and has extended into the urethra and bladder. The rheumatism does not usually follow primarily simple urethritis, and this shows that the severity of the virulent form of the gonorrhœa bears a certain causal relation to its arthritic complications.

There is a question in the mind of the author whether gonorrhœal rheumatism is always due to specific properties of the poison of virulent urethritis, as the disease arises in cases in which, so far as can be learned upon examination of the suspected party, and from a microscopical study of the discharge, there is no reason to believe the

origin of the disease to have been of a virulent character. Under such circumstances the severity of the purulent process is as marked as though the origin of the disease were indubitably virulent infection. Some cases are probably due to mixed infection.

It is probable that cachectic, strumous, gouty, and rheumatic patients have a more pronounced predisposition to the disease than persons who are perfectly healthy.

Symptoms.—The symptoms of the disease resemble those of rheumatic gout rather than the ordinary form of articular rheumatism. As a rule, the local evidences of the disease are not severe, and consequently the constitutional symptoms are comparatively mild, but this is not always true. The disease develops, as a rule, during the decreasing stage, and sometimes occurs during the second or third month. Some authorities claim that it occurs in from five or six to sixteen days, but in most of the cases observed by the author it has occurred later in the course of the disease. The explanation that suggests itself is that the inflammatory thickening of the urethra inhibits to a certain extent absorption from the surface of the mucous membrane. Then, too, abrasion and removal of the epithelium are not so apt to occur within the first few days as later on, when the poisonous material has been in contact with it for some time. The products of the purulent process are not so virulent in the first few days as later in the course of the disease.

There is usually neither diminution nor increase of the urethral discharge coincidentally with the development of the rheumatism; rarely it is lessened, most probably because the patient keeps quiet after the development of joint complications, and this in itself is likely to benefit the urethritis. It is doubtful whether gonorrhœal rheumatism acts as a revulsive or derivative upon the inflammation of the urethra. It is said that, when the rheumatism comes on late in the course of gonorrhœa, there is liable to be an increased discharge for a few days. In this matter the *propter* and *post* are probably confounded; it is more probable that from some particular cause exacerbation of the urethritis occurs with a coincident rapid formation of its characteristic toxic principles; the mucous membrane of the urethra being extensively abraded at this time, absorption readily occurs and produces arthritis or other rheumatic symptoms.

The location of gonorrhœal rheumatism varies in different individuals, and sometimes in the same patient in different attacks.

The structures involved, in the order of frequency, are: (1) articulations; (2) the synovial thecæ of tendons and muscles; (3) synovial bursæ and the sheaths of nerves. Associated with the latter form we may meet with inflammation of the pericardium, the cerebral

meninges, and the deeper structures of the eye. The author has seen several cases in which the eye alone was involved (gonorrhœal descemetitis). A marked predilection is exhibited for the more important joints, the knee being perhaps most often affected. As a rule, the inflammation expends most of its violence upon one joint, although in perhaps the larger proportion of cases several joints are eventually affected.

Varieties.—Fournier presents a classification involving three distinct varieties of the disease, as follows:

1. Generally monoarticular inflammation, most often attacking the knee, occasionally the ankle or elbow. This form is really a passive hydrarthrosis with much effusion, characterized by very insidious development. Pain, tenderness, redness, heat, and constitutional disturbance are either absent or very moderate. Resolution takes place very gradually, and it is usually some months before recovery can be said to be complete; but even in these cases ankylosis may occur. In some instances the mono-articular form is excessively painful, is attended by marked constitutional disturbance, and tends to affect secondarily the bones entering into the formation of the articulation. The fluid in such cases is apt to contain more or less purulent material, strongly resembling that which is discharged from the urethra.

2. A variety not unlike articular rheumatism. This is accompanied by a moderate amount of local and constitutional reaction. Several of the joints are usually involved, and very often the tendons, various other fibroid structures, and the eye are implicated. The symptoms are not so severe as in acute rheumatism, and generally reaction is very mild as contrasted with the magnitude of the joint and other difficulties.

The disproportion between general and local symptoms is an important point in differential diagnosis. The involvement of the joints is usually consecutive, but there is none of the articular delitescence characteristic of acute rheumatism. Profuse sweating, acid urine, and excessive plasticity of the blood, which are so characteristic of inflammatory rheumatism, are usually absent in the gonorrhœal variety. The serous membranes, such as the pleura, endocardium, and pericardium, are not often attacked. A favorable result generally occurs, but chronic synovitis, strumous arthritis in certain subjects, joint stiffness and complete ankylosis are possible sequelæ. Fournier claims that acute suppuration does not occur in gonorrhœal rheumatism; some other authorities say that it is occasionally seen. The author believes that a joint may contain a moderate amount of purulent fluid and still go on to a favorable issue without radical surgical

interference, which is not apt to be the case with ordinary suppurative arthritis.

That suppurative arthritis may occur as a complication of gonorrhœa, the author is convinced from experience.

3. (*a*) This form consists in indeterminate transitory pains in various joints without any local or general evidences of disease. In such cases there is apt to be an exacerbation of the pain, and perhaps a distinct involvement of the joint coincidentally with increase in the urethral inflammation. (*b*) Thecitis occurs, the synovial sheaths become swollen and and somewhat tender, there being moderate redness along the affected tendon in some cases. Movement of the muscle attached to the tendon is very painful. The synovial bursæ may become involved; the one lying under the tendo Achillis and another beneath the inferior tubrosity of the os calcis are most usually implicated. Patients thus affected complain of pain and tenderness in the heel. This particular symptom is not unusual in the course of gonorrhœa. Myalgia, resembling the ordinary form, and peri-neuritis sometimes occur in the course of gonorrhœa, and seem to be attributable in certain instances to the same pathological condition which gives rise to ordinary gonorrhœal rheumatism. Pain in the back, of a severe character, simulating acute lumbago, is very frequently seen; in the majority of instances this is due to over-stimulation of the kidneys by various balsamic preparations, sandalwood being particularly apt to produce it. It does occur, however, in patients who have not taken such drugs. Whether reflex neuralgia would explain these cases is open to question.

Cases are occasionally seen in which gonorrhœal rheumatism limits itself to a single nerve. One of the author's patients has an attack of sciatica coincidentally with every attack of gonorrhœa. Attacks of simple urethritis are sufficient to bring it on in his case. The first attack of gonorrhœa which he ever experienced was attended by sciatica of a very severe character, both nerves being involved.

It is somewhat remarkable that authorities so universally concede the comparative painlessness of gonorrhœal rheumatic processes when, as a matter of fact, quite a liberal proportion of cases are attended by severe pain, and not infrequently by sweats quite as profuse as those which attend ordinary rheumatic fever. The tendency to sweating seems to be most marked at night, the only difference between the perspiration in these cases and that of ordinary rheumatism being the absence of acidity, its more prostrating character, and its greater profuseness.

Ocular Complications.

The ocular complications of gonorrhœa necessarily come under the province of the ophthalmologist, yet inasmuch as they are apt to be primarily presented to the general practitioner, it is proper to devote a little attention to them. There are two forms of ocular complication occurring in the course of gonorrhœa, one of which is due to local infection of the conjunctiva and the other to the same constitutional impression that gives rise to gonorrhœal rheumatism.

As regards the prognosis of the two affections there exists the widest difference, the local infection resulting in a large proportion of cases in destruction of the eye, while the constitutional difficulty is rarely productive of serious results.

Gonorrhœal ophthalmia, or the form due to the constitutional impression of a gonorrhœa, is of a distinctly rheumatic type. It is well known that persons affected with the ordinary form of rheumatism, or those who are afflicted with the rheumatic diathesis, are peculiarly predisposed to inflammation of the conjunctival mucous membrane, and very often of the iris. In this respect gonorrhœal rheumatism is like the ordinary form. Rarely, however, does definite iritis occur, and in several cases which have come under the author's observation the implication of the iris seem to be a coincidence rather than a condition secondary to the gonorrhœa.

According to some authorities gonorrhœal ophthalmia is most often associated with involvement of the joints, particularly when polyarticular. As far as the author's experience goes, however, the ocular complication have appeared to occur in the majority of instances independently of rheumatic symptoms in other situations. The inflammation may attack the conjunctiva, but more often affects the membrane of Descemet, producing the condition known as descemetitis or aquocapsulitis. This is characterized by its insidiousness of onset, the pain at the beginning being comparatively trifling. Later on, however, as a consequence of mechanical distention of the anterior chamber of the eye, there may be considerable pain, varying with the amount of increase in the aqueous humor. In several instances coming under the author's observation there was more or less involvement of the iris, assuming the form of serous iritis, in which the effusion was extensive, giving rise to intolerable pain relieved only by paracentesis. The conjunctiva is usually only moderately reddened, lachrymation being considerably increased. The function of the eye is disturbed but slightly, objects having a somewhat cloudy or smoky appearance. Hemorrhagic effusion in the anterior chamber has been described. As a consequence of serous

effusion, the cornea becomes bulging and prominent, and *pari passu* with the increase in this corneal bulging the pain becomes more severe.

A form of catarrhal conjunctivitis, secondary to urethritis, is described by Fournier, and is supposed by him to occur independently of contagion. It is probable that such cases occasionally occur, although it would be difficult to exclude the possibility of mild infection. Reasoning from the effects of ordinary rheumatism upon the conjunctiva, it is reasonable to suppose that a similar catarrhal condition of the mucous membrane might result from gonorrhœal rheumatism. It is easily conceivable that the contraction of a coryza during the existence of rheumatic irritation of the structures of the eye in the course of a urethritis might readily result in the production of gonorrhœal conjunctivitis.

Both eyes may be attacked in gonorrhœal ophthalmia, usually consecutively, simultaneous involvement being the exception rather than the rule. The prognosis is generally favorable, although, when iritis is a prominent factor in the case, synechiæ, with consequent disturbance of the functions of the iris, may result. It is possible, moreover, that complete occlusion of the pupil by inflammatory lymph may occur.

Gonorrhœal conjunctivitis is a far more serious condition than that which has just been considered, and is due to infection of the conjunctiva with the irritating products of a virulent urethritis. It is in no way different from ordinary purulent ophthalmia of a nonvenereal type, unless, perhaps, it be more serious upon the average and more highly infectious. Its prognosis in the majority of instances is unfavorable. As the disease belongs more properly to the department of ophthalmology, it is unnecessary to do more than to allude to it as one of the possible and lamentable complications of urethritis. The danger of conveying infection to the eye by towels or the fingers should be impressed upon the patient by his medical adviser.

Bubo.

Urethritis is occasionally complicated by bubo. As a rule, the glands enlarge but slightly and are only moderately tender. A moderate degree of tenderness in the groins, accompanied by little, if any, enlargement of the inguinal glands, is quite frequent in severe cases. The enlargement of the glands may increase until a pronounced inflammatory bubo develops. This is the variety of bubo formerly known as sympathetic. It is due in every instance to secondary lymphatic infection by pus microbes. Suppuration is un-

usual, or at least pus rarely forms in sufficient quantity to produce a distinct abscess. It is the author's opinion, however, that in many cases in which a distinct bubo forms, but resolves without the formation of a clearly defined abscess, minute foci of suppuration exist throughout the gland structure. This assertion is based upon the appearance of a number of cases of this kind in which the glands have been extirpated. The foci of suppuration are chiefly distributed in the periphery of the gland. When one or more of these foci rupture externally, peri-adenitis and phlegmonous abscess develop. Suppuration is most apt to occur in strumous, tuberculous, or otherwise cachectic subjects. Patients recently syphilized are also liable to pus formation in the affected glands. Trauma or straining efforts in lifting and over-exertion of any kind appear to have some influence in determining the occurrence of bubo.

Balanitis and Balano-Posthitis.

Inflammation of the mucous membrane of the glans penis—balanitis—and of the preputial reflexion—posthitis—are frequent complications of gonorrhœa. The two conditions are usually associated—balano-posthitis. These conditions are due to irritation produced by retained and decomposing secretions—usually beneath a tight and elongated prepuce, although this is not absolutely necessary.

Pus forms upon the inflamed surface, which becomes reddened, tender, and excoriated from maceration and removal of its epithelium. Ulcerations of an herpetic or chancroidal character may be formed. It is the author's opinion that typical chancroid may be developed *de novo* under a tight and inflamed prepuce. Bubo may result from the balanitis rather than from the gonorrhœa on which the latter depends.

Vegetations.

As a result of prolonged irritation, combined with some peculiar instability of local nutrition—or tropho-neurosis—some patients develop fungoid growths upon the mucous membrane of the glans and prepuce. These are composed of heaped-up epithelium, covering delicate, capillary, vascular loops. They are very fragile, painless, and bleed readily. They resemble the vegetable fungi in that their development is favored by heat, moisture, darkness, and filth. They are not unlike a cauliflower in their physical appearance. When the conditions favoring their growth are perpetuated, they sometimes attain an enormous size. They are especially likely to develop in women. They may undergo transformation into hyperplastic tumors, particularly in women. The term venereal vegetations, oftentimes

applied to these growths, is a misnomer, as they are in no sense venereal, and may appear in patients who have never had venereal disease of any kind. The author is, however, inclined to the belief that syphilis is often a predisposing factor.

Balano-posthitis is very favorable to the development of vegetations, and they are quite likely to develop in any case where the prepuce is long or constricted.

Lymphangitis.

Inflammation of the lymphatic vessels of the penis occasionally occurs in urethritis. The prepuce becomes swollen and œdematous, and sometimes presents an appearance identical with erysipelas. Abscesses may form along the lymphatic vessels. Occasionally the inflammation is limited to a few lymphatic vessels, and does not involve the entire prepuce.

Lymphangitis is due to secondary and probably mixed infection rather than to the germs of the urethral inflammation *per se*.

In cachetic subjects, sloughing of the prepuce and denudation of the penis may occur.

Chronic induration—indurating œdema—is an occasional result of lymphangitis. This is most likely to occur in syphilized patients.

Treatment.

The treatment of urethritis comprises a greater variety of methods and remedies than almost any disease which could be mentioned. This fact is in itself strong circumstantial evidence of the self-limited and—as far as specific medication is concerned—incurable character of the disease. Manifold as are the panaceas and specifics for urethritis, the fact still remains that no system of treatment or line of specific medication, when taken alone, has materially diminished the average duration and severity of the disease, excepting those measures based upon the principle of its self-limitation and an appreciation of the inadvisability and impracticability of attempts to jugulate it. Such measures of treatment have accomplished much; panaceas, nothing but injury on the average. There is scarcely a physician in practice, and probably not one "man about town," but imagines that he has a remedy which is a specific for the "clap," the several remedies varying in position and legitimacy from the fallacious injection *Brou* to the more modern application of the bichloride of mercury by the retro-injection method. The author discredits the statements of those surgeons who claim to cure cases of virulent urethritis in a week or ten days, or perhaps less, quite as much as the statements of the vet-

eran "rounder" who has a little preparation that "knocks it in three days." It is not to be believed that by any special system of medication a virulent urethritis is ever cured in any such time. The author has hunted down all the wonderful specifics that have ever been called to his attention, and has tried them all faithfully, but has not yet succeeded in finding a remedy which produces the wonderful results claimed by some surgeons and by quite a proportion of patients.

Mr. Milton has well illustrated the fallaciousness of gonorrhœal specifics in a list, taken from various sources, which comprises several hundred infallible remedies, all of which have been tried and found wanting.

Driving a gonorrhœa to a cure is bad, as well as unsuccessful, practice in general, and much harm may come of it; the best results being apt to follow a "coaxing" method, *i.e.*, mild and persistent treatment and the acceptance of the inevitable for several weeks. There is but one substitute for this line of treatment, and that is one which will be shortly mentioned, involving absolute rest. If a remedy is ever discovered which will cure every case, even in from three to six weeks, the event will be hailed as presaging a surgical millennium. The author would be very well satisfied if a remedy could be found which would invariably cure gonorrhœa in six weeks or so, meanwhile permitting the patient to go about his business. No matter what system of treatment may be followed, a better average result than this is not often to be hoped for in virulent urethritis. If, however, the surgeon counts his cases of bastard clap and the milder forms of urethritis in with his statistics, he may achieve in a large proportion of instances the wonderful results claimed by many, and this remark is particularly pertinent when we consider the fact that the average surgeon must necessarily treat at least a half-dozen cases of mild urethritis or bastard clap for every virulent case that comes under his observation. It will be found that, with due regard to the self-limitation of the disease and the intolerance of the urethra for harsh measures of treatment, fewer cases of chronic urethritis will be seen, and fewer strictures and other sequelæ will result, than with those systems of treatment which are said to cure within a few days. There are, to be sure, cases which will present themselves to our observation that are likely to shake our faith in this method of management. How often we hear of some self-satisfied voluptuary who some years ago had a gonorrhœa that proved obstinate to the best professional skill for months and months, but who finally recovered and now has a prescription which has cured him of from half a dozen to twenty attacks of urethritis!

The surgeon should not let such cases shake his faith in his own professional ability, for these men are constantly deluding themselves. The only virulent urethritis that the patient under consideration ever had was the first attack, from contagion, the subsequent attacks being bastard clap founded upon the damage done by the old-time gonorrhœa. Sooner or later a second attack of violent urethritis—or perhaps a mild case with a tendency to chronicity—is experienced by such patients and not only explodes their faith in the erstwhile panacea, but gives no end of trouble, and necessitates for its cure surgical measures adapted to the removal of the cause of those numerous attacks which the alleged specific so readily subdued.

In spite of what has been said regarding the parasitic or microbic origin of virulent urethritis, the author fails to see any practical results in the way of improved methods of treatment—not that this is in any sense an argument against the microbic character of the disease, but it certainly signifies its self-limitation. The investigations of bacteriologists who unhesitatingly accept the gonococcus of Neisser have shown that the poison of the disease infects the entire thickness of the mucous membrane and the submucous cellular tissue so completely that repair cannot take place in well-pronounced cases until the layers of affected cells have been replaced by new and insusceptible connective-tissue cells from beneath. This condition of affairs proves positively that nothing short of caustic applications capable of destroying the entire thickness of the mucous membrane can by any possibility abort a virulent urethritis when once it is thoroughly established. As a corollary, it is obvious that attempts at the abortion of a virulent urethritis should be made only in the very incipiency of the disease, before, in fact, it is possible to determine whether or not we have to deal with a simple or virulent case of inflammation; for inasmuch as the different grades of urethritis often begin in precisely the same manner, it is impossible to tell for a few hours, or perhaps several days, whether or not we have to do with a virulent type of the affection or with the simpler and more curable variety. Any form of treatment the efficacy of which is supposed to depend upon the action of antiseptics on the specific germs of the disease must, in order to shorten the duration of the affection, be applied within a few hours of its inception. Thus the disease can be aborted—if the term abortion is proper as applied to something which does not already exist; the poison begins to produce irritation of the epithelium of the urethral mucous membrane very soon after its introduction into the canal, and if the virus be destroyed *in loco*, the disease not having yet fairly begun, it may be said to have been prevented rather than aborted.

The two methods of treatment applicable to urethritis may for the purpose of discussion be divided into the jugulative or abortive and the methodical or rational systems.

Abortive Treatment.

The abortive method of treatment has been generally understood to imply the substitution of a simple for a specific inflammation. This practice is a relic of bygone days, which has impelled surgeons of excellent reputation—and undoubted wisdom in other directions—to rub the pure crayon of nitrate of silver in eyes affected by virulent conjunctivitis. It is even possible that there are surgeons at the present time who advocate this very method of treatment for this particular disease. During the author's term of service as hospital interne, he saw pure nitrate of silver applied on several occasions, and in every instance it was followed, not by the substitution of a simple for a specific inflammation, but by complete destruction of the eye as far as its visual capacity was concerned. The author remembers asking one of the hospital staff who applied this method of treatment in a case of virulent ophthalmia, under the advice of a prominent specialist, how he knew which had destroyed the sight, the disease or the treatment. He replied that it was impossible to say positively, but that it must be the disease, because "they all went that way anyhow." Arguments are useless as opposed to such logic as this, but it is hoped that it is unnecessary to protest against such pernicious doctrines as applied to the treatment of urethritis.

The abortive method of treatment as applied to urethritis should properly imply, not the fossilized and sophisticated idea of the substitution of one type of inflammation for another, but (1) the removal as far as may be of the virulent germs which have been deposited upon the surface of the mucous membrane, and which, although they have begun to manifest their presence by slight irritation at the meatus or just within it, have not yet deeply penetrated into the substance of the mucous membrane and infected the subjacent cells; and (2) the neutralization of the germs and their products by means of antiseptics or germicides—which in this instance imply all chemical substances capable of neutralizing the organic poison of urethritis without destroying the mucous membrane.

These requirements are the more readily fulfilled because the disease begins at the meatus, or at most in the fossa navicularis, and gradually affects contiguous areas of mucous membrane. The substance most generally used in the abortive method of treatment is nitrate of silver. This may be used in two ways: (1) By the injec-

tion of a mild solution at frequent intervals; (2) by means of a single injection of a comparatively strong solution. If properly done, and at an appropriate period in the incipiency of the disease, either one of these methods is usually safe and is not likely to result in stricture—the principal danger of the abortive method. A solution of nitrate of silver, fifteen grains to the ounce, may be thrown into the canal by means of a small drop syringe, which is passed into the urethra for about two inches, the fluid being ejected as the syringe is slowly withdrawn. It is held in the urethra for a few seconds, and a weak solution of chloride or bicarbonate of sodium is then thrown into the canal, the patient being instructed to urinate immediately thereafter. If this be carefully done when slight discharge and itching at the meatus are first observed, the method is apt to prove successful and is devoid of danger, although in general it is not a good method for application by the general practitioner. In lieu of the strong preparation, a solution of one-half grain of nitrate of silver to the ounce of water may be given and used every two hours for twenty-four hours or less, the treatment being stopped as soon as pronounced smarting during micturition develops.

That nitrate of silver is efficacious in destroying the *materies morbi* of virulent inflammation is shown by the excellent results obtained by Credé in the prophylaxis of ophthalmia neonatorum by the instillation into the eyes of the new-born infant of a two per cent. solution of that drug. While the use of the nitrate of silver in careless hands is inimical to the welfare of the urethra, the author is satisfied that, if properly used, its dangers are greatly exaggerated. Injections in a strength of thirty grains to the ounce may often be used in chronic urethritis, with the best possible results. Such injections, however, should only be given by the deep syringe.

The method which the author prefers for the abortion of urethritis is the prolonged and systematic irrigation of the anterior urethra with a solution of permanganate of potassium in a strength of from 1 in 10,000 to 1 in 5,000. This should be used as warm as can be comfortably borne by the patient and kept up for one-half or three-quarters of an hour at a time, the process being repeated twice daily for three or four days, after which time the treatment should be given once daily for two or three weeks. Care should be taken not to use the water too hot, as destruction of the urethral epithelium may easily be produced; this is a point too often forgotten. The patient may occasionally receive benefit from this same treatment if self-administered by means of the ordinary penis syringe, although irrigation through the short nozzle at the hands of the surgeon is best. Long nozzles for irrigation should not be used. The author has found a

short nozzle of his own device to be the most satisfactory of all the irrigating appliances that he has used. The irrigation should be made by means of the ordinary fountain syringe, care being taken not to have the elevation of the douche bag too great, as injurious pressure upon the urethral walls may be thereby produced. During the continuation of this treatment, the patient should be placed upon the usual internal treatment with alkalies, and the usual restrictions regarding diet and exercise should be imposed. It is sometimes advantageous to combine the internal administration of oil of sandalwood with the irrigation method. The author would especially enjoin caution in the matter of too speedy cessation of treatment. As a rule no discharge will be noticeable after the first twelve or twenty-four hours, hence it is very often difficult to convince patients of the necessity of several weeks' careful treatment. Experience shows, however, that unless prolonged treatment be instituted, the development of the disease will be simply retarded, not aborted.

Rational or Methodical Treatment.

General Management.

The rational method of treatment is of necessity the one which we are most often called upon to prescribe, for the reason that, as a rule, the patient rarely seeks advice until urethritis is well established.

The term "rational" is used in contradistinction to the expectant method of Fournier, Diday, and others, which consists chiefly in the administration of placebos.

In cases of simple urethritis, mild measures of treatment may be directly curative, which cannot be said of the more active types of the disease. Attention to genito-urinary hygiene, regulation of the diet, the administration of mild laxatives, and the use of weak astringent injections usually suffice for the cure of the milder cases within a few days; at least, such measures check the discharge. From what has been said of the causes of the simple forms of inflammation of the urethra, it is obvious that in the majority of instances surgical treatment is necessary for a complete cure, either in conjunction with medical treatment or following the cessation of the urethral discharge. Thus dilatation or cutting operations are required for stricture; the contracted meatus must be cut and congested and granular patches must be stimulated to repair by means of applications through the endoscope, or other measures applicable to the treatment of certain forms of chronic gleet must be instituted.

So intimately connected are simple urethritis and chronic pathological conditions of the canal that it is unnecessary to discuss further

the treatment of what must obviously be in the majority of instances merely a symptom. The author sometimes wonders whether it would not be safe to distinguish broadly simple from virulent urethritis by saying that the simple form comprises the effects of venereal excitement, intemperance, and contact of irritating secretions or a special poison with a canal at one time affected with severe inflammation, while virulent inflammation is the result of inoculation of a highly elaborated poison upon the virgin urethra, with or without the co-operation of the other factors just mentioned. The author is tempted to believe that an individual who has once had a virulent attack of urethritis becomes so insusceptible to the disease that infection, when taken alone, never thereafter causes a virulent type of inflammation, apparently virulent (secondary) attacks being due to the super-addition of some extraneous source of irritation. This may seem far-fetched, but let it be remembered that the subsequent history of the gonorrhœal patient is usually a succession of comparatively mild attacks. Is this because he is more choice in his selection of females? But, it may be urged, "the mild attacks are due to pre-existing damage in the canal," *i.e.*, remnants of the old attack. Very true, but wherein do such lesions protect the patient from virulent attacks, if exposure be granted—as it must be in most cases?

The most important principle in the management of severe urethritis is the maintenance of physical and sexual rest. It would be fair to qualify the statement that there is no specific for urethritis by saying "with the exception of absolute rest," so great is the benefit to be derived from it. It is an unfortunate circumstance that individuals with gonorrhœa labor under the fatuitous idea that the disease is in itself not a serious one—as they usually express it, "no worse than a cold,"—and it is consequently difficult, indeed it is impossible, in the majority of cases, to induce them to take a complete rest. They wish to be cured promptly, but upon entirely different principles from those which govern the management of other acute inflammatory affections. A man with a sharp attack of urethritis is certainly very sick, yet how seldom can he be induced to take to his bed and be treated upon the same rational principles that are carried out in other inflammations! A man with a fractured limb is of necessity compelled to rest, and independently of the mechanical obstacle to movement, it is not difficult to convince him that absolute quiet is necessary for a cure. There is little or no danger in a simple fracture, yet the patient is perfectly tractable. There is great danger, usually, in cases of virulent urethritis, yet it is seldom possible to convince the patient that quiet is necessary. A moment's reflection will convince the reader of the truth of the assertion that there are few dis-

eases indeed that are characterized by so many and such severe remote pathological possibilities as is that under consideration. Many a man, crippled at middle age, and whose life is ever after afflicted with numerous physical annoyances or perhaps serious bodily infirmities, is indebted therefor to a severe attack of gonorrhœa experienced in his youth. The immediate results of a gonorrhœa are often bad enough. There is nothing more painful than an attack of epididymitis, a disease which may produce sterility, and in certain constitutions may lead to abscess or gangrene and total loss of the organ involved. This complication is among the most frequent results of urethritis. Inflammation of the bladder, of an acute and dangerous form, is occasional, and is productive of much suffering. Should the bladder become involved in any degree, it is indeed a fortunate individual who is not ever thereafter annoyed with vesical irritability, or perhaps chronic inflammation. Prostatitis also leaves disagreeable and usually permanent effects.

Stricture, the most important of the sequelæ of gonorrhœa, is productive in some instances of the most profound pathological disturbances in the proximal portion of the genito-urinary tract. Inflammation of the bladder, calculous disease, inflammation and dilatation of the ureters, surgical diseases of the kidney, and even Bright's disease of the ordinary form, are often directly traceable to it. There are very few individuals who have suffered from pronounced stricture, who are not affected either with renal disease or with what is practically the same thing, a *locus minoris resistentiæ* in the direction of the kidneys, which favors the development of acute or chronic Bright's disease from apparently trivial causes. There are few cases of gonorrhœa, indeed, but affect to a greater or less extent the prostate body, and it is the author's view that many individuals who in after-life are afflicted with prostatic hypertrophy owe that condition to the effects of an early gonorrhœa.

It needs but a casual survey of the morbid possibilities of urethritis to convince one that it is a serious affection. It is an undeniable fact that gonorrhœa is the most dangerous of the venereal diseases, for through the medium of its sequelæ and complications the disease is the cause of more deaths than can be justly attributed to the direct or indirect influence of syphilis. By comparison, chancroid is essentially a benign disease. Subtract the evil effects of gonorrhœa from the list of human ills, and the resulting increase in the longevity and happiness of the race would be something marvellous.

It is the author's belief that every patient with a virulent urethritis should be confined to his bed for from one to two weeks, and that, if this could be accomplished, the majority of cases would not only

be subdued within two or three weeks, but stricture and other complications and sequelæ would be almost unheard of, providing the medical and surgical treatment adopted in conjunction with rest were not in itself productive of injury. In the comparatively few instances in which the author has been able to carry out this plan, the results have invariably substantiated this opinion. Sexual rest is a positive necessity, and it is hardly necessary to state that this implies both mental and physical sexual repose. The mind must be kept free from sexual impressions and ideas of all kinds.

Second only in importance to rest is attention to diet. A restricted regimen is necessary, not only because of its beneficial effects from an antiphlogistic standpoint, but for the purpose of limiting the waste products excreted with the urine. It is upon the amount and character of these waste products that the irritating properties of the urine depend, and there is nothing so efficacious in diminishing its acridity as attention to diet, the ideal regimen being bread and milk. Stimulants, such as alcoholics of all kinds, tea and coffee, should be interdicted. The more closely a vegetable diet is adhered to the better, providing a bread-and-milk regimen be not acceptable. Asparagus and tomatoes, however, are to be avoided.

It is not considered necessary by the majority of surgeons to restrict the patient in the manner of indulgence in tobacco. Chewing is probably not at all injurious, but this is not true as regards smoking. Practical observation shows that smoking, unless in extreme moderation, is decidedly inimical to the cure of inflammatory troubles of the genito-urinary tract. It is well, therefore, to prohibit it as a matter of routine. Some of the author's patients have acknowledged that they have themselves noticed a difference in their condition according to the extent of their indulgence in tobacco. The late Dr. Bumstead held the opinion that both smoking and chewing produced relaxation of the genital organs and tended to perpetuate urethral discharges. Tobacco in excess certainly makes the nervous system irritable and tends to promote sexual excitability. The evil influence of smoking upon the mucous membranes is probably not limited to those of the nose and throat, but also extends to all the mucous tracts of the body through the constitutional effects of the weed.

The alkaline mineral waters should be given for the purpose of diluting and increasing the bulk of the urine. To these mineral waters may be added the citrate, acetate, or bicarbonate of potassium with the object of still further lessening the irritating properties of the urine by neutralizing its acidity. Profuse diuresis, providing the urine is bland and non-irritating, is highly desirable, for the urethra is like an infected wound in a certain sense, and

requires frequent irrigation for the purpose of cleansing the infected surfaces.

Cleanliness is absolutely essential, and individuals with a long prepuce should be particularly cautioned to cleanse the parts beneath it thoroughly, and, if possible, to retract it and bathe the glans several times daily, to prevent balanitis and further cultivation of the products of virulent inflammation.

Some attention is necessary to the dressing of the penis. One of the most pernicious practices that can be adopted is to bind absorbent cotton or other material over the meatus, a plan which is frequently followed by patients with a long prepuce, in the orifice of which absorbent cotton or lint may be packed with great facility. Common sense should teach the surgeon that, inasmuch as the inflammation of the urethra is due to the inoculation of successive areas of the mucous membrane with the virulent products of inflammation, the process extending gradually from the anterior to the deeper portions of the urethra, any dressing which dams back the discharge must necessarily feed the pathological process and enhance the danger of its extension into the deeper portions of the canal. Improper dressing is frequently the cause of serious complications. A very simple plan is for the patient to roll the shirt up in front out of harm's way and to pin upon the tail of that garment a soft white handkerchief or napkin, which is drawn through beneath the perineum and up over the penis in such a manner that one corner of the napkin may be tucked down each leg of the pantaloons, with numerous folds of the soft cloth resting in the crotch of that garment in such a way that the penis rests therein, the meatus at the same time being unobstructed. Another very excellent plan is to pin the toe of a stocking upon the drawers or pantaloons in such a manner that the penis may hang therein without the meatus coming in contact with the improvised bag. In the bottom of this receptacle a little absorbent cotton may be placed and frequently changed. There are several cloth gonorrhœa bags upon the market which answer the same purpose. The penis should never be dressed and allowed to remain in the upright position. By attention to these little details cleanliness may be secured, and at the same time free drainage of the affected membrane facilitated. Rubber protectives should never be used.

Inasmuch as it is impossible for us to abort the inflammation when it has already frankly begun, it is obvious that we must content ourselves with a not too officious management of the case until the normal process of repair begins.

One of the best measures for facilitating resolution of inflammation

is the application of heat, and it is nowhere more efficacious, if properly applied, than in inflammations about the sexual apparatus. It will be found that heat applied by means of the sitz-bath of from one-half to one hour's duration several times daily will materially assist in the successful management of the urethritis, particularly if there exists any irritation about the prostate or neck of the bladder. When the patient will consent to keep perfectly quiet, it is the most valuable auxiliary method of treatment at our command. The value of the hot sitz-bath has been questioned, but the author is convinced of its efficacy.

In lieu of the more general application of heat by means of the bath, prolonged soaking of the penis in hot water will be found to be beneficial. When urination is very painful, relief may be obtained by passing the urine while the organ is immersed in a vessel of hot water.

The use of remedies, both internal and local, should be guided, not only by a knowledge of the natural course of the disease, but by the conditions present at various stages of the affection in each individual patient. It would be absurd, as well as pernicious, to treat a case complicated in the stationary stage by inflammation of the bladder or prostate in the routine fashion prescribed for the average uncomplicated case at the same period of the disease.

Internal Medication.

The range of application of internal medicaments in acute urethritis is not very extensive, the so-called specific remedies being especially limited in number. During the increasing stage of the disease there is apt to be considerable fever, and the tincture of aconite or veratrum viride will be found to be useful. The author believes that these remedies are not used sufficiently often.

Alkaline diluents should always be given throughout the course of the disease, either alone or in combination with other drugs. The fluid extract of pichi (*Fabiana imbricata*), a drug recently put upon the market, appears to have an excellent effect in lessening the irritating properties of the urine and soothing the inflamed mucous membrane. Combinations of buchu, slippery elm, uva ursi, linseed, etc., are all beneficial, especially if given in infusions, their action in this disease being essentially the same as in inflammation of the bladder. The ergot of rye and the ergot of corn (*Ustilago maidis*) have been recommended as exerting a specific effect upon the disease. In the early stages of the affection ergot does not seem to be of any particular service, and, moreover, is very disagreeable to take. In the later

stages of the affection, however, it undoubtedly exerts an astringent influence upon the inflamed surface, and may be given in quite liberal doses, with marked benefit in some cases.

The fluid extract of corn silk (*Stigmata maidis*), in doses of one drachm every two or three hours, has been highly recommended in the treatment of the acute stage of gonorrhœa. The author has failed to notice any special benefit derived from this remedy in acute gonorrhœa. It has, however, seemed to be beneficial in some cases of catarrhal gleet.

It is desirable to administer some anaphrodisiac preparation during the height of the disease for the purpose of allaying sexual excitement and producing a direct sedative influence upon the inflamed part. A dose of twenty to thirty grains of bromide of potassium at bedtime has usually the desired effect. If a more powerful effect is desired, the following mixture will be found serviceable:

℞ Fl. ext. ergotæ ..... ♏xv.
Tr. gelsemii ..... ♏v.
Potassii bromidi ..... gr. xx.
Tr. hyoscyami ..... ♏xxx.
Syr. aurantii ..... q. s. ad ℥ss.
M. Sig. At bedtime.

The following is also serviceable:

℞ Chloralis hyd ..... gr. v.
Tr. aconiti rad ..... ♏iij.
Sodii bromidi ..... gr. xv.
Aq. camphoræ ..... q. s. ad. ℥ss.
M. Sig. At bedtime.

Either of these combinations will usually allay sexual excitability and prevent or relieve severe chordee. It may be necessary, however, in some cases in which erections are painful and troublesome, to administer an opiate. Opium has a certain degree of stimulating effect upon the sexual organs, which rather detracts from its efficacy as an anodyne in these cases. This objectionable feature may be avoided by combining the deodorized tincture of opium in moderate doses with either chloral or the bromide of potassium. Where these various remedies prove unsuccessful, the cold-water coil will invariably afford relief and has in addition a decidedly beneficial effect upon the inflammation. If the patient sleeps upon a hard bed, with a knotted towel applied about his waist in such a manner that he cannot comfortably lie upon his back, painful erections are not so apt to occur.

Morphine is sometimes necessary, and is best given by suppository, plain or in the following useful combination:

℞ Morph. sulph ..... gr. $\frac{1}{12}$.
Ext. hyoscyami ..... gr. $\frac{1}{4}$.
Camphoræ monobromidi ..... gr. v.
M. Ft. suppos. No. 1. Sig. At bedtime.

The remedies most relied upon in the treatment of gonorrhœa are the various balsamic preparations. These should not usually be given during the increasing stage of the disease, and it would seem that more marked benefit is to be derived from them when they are not used early in the case. There is, perhaps, no objection to the administration of the oil of sandalwood in the increasing stage; cubebs and copaiva, however, are more stimulating, and consequently inadvisable at this time. Sandalwood oil is best administered in the form of capsules containing from ten to fifteen minims. Of these, from four to ten may be given daily. In lieu of the capsules the pure oil may be given in doses of ten to fifteen drops upon a lump of sugar, this dose being repeated four or five times daily. The limit of tolerance is usually indicated by stomachic disturbance, or quite frequently by pain in the back resembling lumbago, this being probably nephralgia dependent upon over-stimulation and consequent irritation of the kidneys. Sandalwood is much more likely to produce this result than are copaiva and cubebs. During the stationary and declining stages copaiva and cubebs may be given alone or in combination. Of these two drugs, cubebs is the most stimulating to the mucous membrane of the urethra, but least irritating to the stomach. Copaiva occasionally exerts an unpleasant effect in the form of an efflorescence or rash upon the surface of the skin, which is sometimes so pronounced as closely to simulate measles. The cause of this untoward action of copaiva is not known. It would appear, however, that the eruption is produced through the medium of idiosyncrasy, by an impression made by the drug upon the sympathetic nervous system, analogous to that produced in some individuals by the ingestion of shell fish, over-ripe tomatoes, etc. Quinine and several other drugs have been observed to produce a similar reaction of the skin, probably in the same way. It is possible that defective renal elimination and vicarious skin action has something to do with these cases.

Cubebs and copaiva may be given in doses of ten to twenty drops of the oil, four or five times daily, either in capsules or in the form of an emulsion. The author prefers the emulsion where the patient does not object to it. The doses of the balsams may be increased to the limit of tolerance, but it is wise not to give them too liberally

until the disease begins to decline. There are no better combinations in the way of balsamic emulsions than the following:

℞ Liq. potassii ..... ʒ iv.
Bals. copaibæ ..... ʒ i.
Ol. gaultheriæ ..... ♏x.
Ext. glycyrrhizæ fl. ..... ʒ ss.
Muc. acaciæ ..... q. s. ad ʒ iv.
Sig. A teaspoonful every two or three hours.

℞ Ol. cinnamomi ..... ♏x.
Ol. cubebæ,
Sp. æther. nit. ..... āā ʒ ss.
Muc. acaciæ ..... q. s. ad ʒ viij.
M. Sig. A tablepoonful three or four times daily.

Cubebs may be given in powder in doses of one drachm, two or three times daily, and this method of administration sometimes agrees with the stomach very much better than either the emulsion or capsule. The formulæ given are more or less illustrative, and may be varied according to the judgment of the practitioner. Vidal advocates the use of gurjun balsam in doses of two grammes before each meal. Dr. R. W. Taylor speaks favorably of the tincture of cannabis sativa in doses of ten to fifteen drops in water three or four times daily.

In the later stages of gonorrhœa, in which there is a tendency to chronicity, turpentine is occasionally of value, the white or Canada turpentine being the best variety. The author has obtained benefit in some cases from the administration of the following:

℞ Terebinth. alb ..... ʒ i.
Res. podoph. ..... gr. ss.
Camphoræ monobromidi ..... ʒ i.
M. ft. pil. no. 30. Sig. One pill four times a day.

In some instances in which the patient is debilitated, the addition of iron to the balsamic preparations is advisable for its tonic and astringent effect. Matico and other vegetable preparations containing tannin are recommended for internal administration, but the author has failed to note any benefit from these drugs, with the possible exception of Hydrastis canadensis, which has seemed to be of service in some cases of chronic urethritis.

The beneficial effect of the balsams when administered internally is rather peculiar, inasmuch as when locally applied by means of injections they have apparently no action whatever. It would appear that in their passage through the digestive tract and circulation they undergo some chemical change, by virtue of which they exert a spe-

cial soothing effect upon the inflamed mucous membrane. That they exert any specific (microbicidal) influence over the poison of virulent urethritis is highly improbable. Their effect is certainly not constitutional, as they are of absolutely no service in gonorrhœa in the female, unless the urethra is involved.

The local use of copaiva in its natural state does not seem to be beneficial. As a matter of curiosity, however, it may be mentioned that it has been recommended for local use in vaginitis. M. Baratier (Thèse de Paris) recommends the use of copaiva in the form of vaginal suppositories for gonorrhœa in the female, these suppositories containing also the extract of opium. Inasmuch as this is said to cure "in about twenty days," it is hardly necessary to comment upon it as a means of specific medication, for certainly a remedy which would not bring about a cure in less time than this can hardly be said to be very efficacious as a specific.

The test has been made by M. Ricord and others of injecting the urine of patients who were taking large quantities of copaiva into the vaginæ of women and urethræ of men affected with virulent inflammation, the effect being decidedly beneficial. Raquin, of Paris, has prepared a solution termed by him copaibate of soda, which is said to be useful as an injection as well as internally.

Aperient medicines are beneficial throughout the course of urethritis, particularly during the acute stage. The saline laxatives are especially beneficial; the various natural mineral waters, notably the Friedrichshall and Hunyadi Janos, being the best of these. The Carlsbad salts are also of service. It should be remarked in this connection that constipation is invariably attended with more or less congestion of the prostate, and possibly of the urethra, and its correction is therefore desirable. Bruising of the prostate during a difficult stool may constitute the point of departure for prostatic complications in the course of acute urethritis.

Naphthol is a remedy recently recommended in urethritis. This agent is claimed to act by becoming decomposed and thereby converted into some modification of phenol (or carbolic acid), which, coming in contact with the mucous membrane of the genito-urinary tract, is supposed to destroy the germs of the disease. It has been given in doses of from two or three to fifteen grains, several times daily. It would appear to be indicated in chronic vesical inflammations rather than in urethral troubles, inasmuch as it probably makes the urine less putrescible. It is apt to disturb the stomach, and, as the process in gonorrhœa is an active mixed infection rather than a septic process, the writer cannot appreciate its advantages over some other drugs.

Local Medication.

Local medication in acute urethritis is best accomplished by means of injections.

A great deal of discussion has been evoked regarding the advisability of the injection method of treatment in gonorrhœa. There is a deep-grounded, and in many instances, it must be confessed, justifiable, prejudice against their use entertained by the laity, and incidentally by some surgeons. It is supposed by many that the injection method is usually responsible for stricture and other untoward complications and sequelæ of urethritis. While this prejudice is undoubtedly founded in some instances upon a substantial basis, the author ventures to assert that it is the abuse and not the use of injections that is responsible for their unpleasant results. Injections of simple water, if improperly used, may produce injury, and it is certainly true that unreasonably strong astringent or antiseptic drugs will, as a rule, produce unpleasant results. Any injection of a strength sufficient to produce severe pain is probably strong enough to destroy the already partially devitalized epithelium upon the surface of the mucous membrane, and as a consequence there must necessarily occur at various points localization and intensification of the inflammatory process. Given at the proper time and in a proper manner and strength, injections are not only harmless but very beneficial and really prophylactic of stricture and other complications, by limiting the severity and duration of the inflammatory process. Any form of injections which is given for the purpose of cutting short the disease during the height of the inflammation is apt to produce injurious results. It is an unfortunate fact that many surgeons have joined in the popular prejudice against injections, for, as a consequence, nearly every patient who has stricture resulting from a gonorrhœa which has been treated by the injection method, no matter how skilfully and beneficially, attributes the permanent injury of the canal to the treatment of his urethritis; should he consult a surgeon of anti-injection proclivities, he is certain to have his erroneous ideas confirmed, much to the detriment of the reputation of his former surgeon, who perhaps treated his urethritis upon strictly scientific and conservative principles.

One of the most important points in connection with the injection method of treatment is the selection of an appropriate syringe. The ordinary glass syringe, or the hard rubber syringe with a long nozzle, is perhaps responsible for more prolonged cases of urethritis than any that could be mentioned. The introduction of such instruments, even when performed very carefully, invariably excites more or less

mechanical irritation, and it is not unusual to detect in long-standing cases a congested and granular patch of mucous membrane precisely at the spot upon which the nozzle of the syringe impinges during injection. Very few surgeons devote much attention to the instruction of the patient in the proper use of the syringe, or to the selection of an appropriate form of this instrument. The author has seen not a few cases of chronic urethritis which subsided immediately upon the cessation of the use of faulty syringes. In some cases a cure will result from the use, with a proper syringe, of the same astringent solutions which have failed to produce any effect whatever when injected through one of the long-nozzled abominations. The best form of syringe is that with a conical point, known as the "Excelsior-P," manufactured by the Goodyear Rubber Company. The instrument must be of moderate capacity in order to accomplish any benefit; if it does not contain sufficient fluid to thoroughly distend the urethra when thrown into the canal with a moderate degree of force, the medicament is never brought in contact with the entire diseased surface. In using the syringe, the patient should be instructed to urinate first, and thus clear away the purulent secretion as far as possible, and then to inject the fluid slowly and steadily into the canal. Too great or spasmodic force is liable to drive the fluid—and, with it, germ infection—into the deep urethra and produce prostatic, vesical, or testicular complications.

During the increasing stage of urethritis, injections, if used at all, should be very mild—they may usually with advantage be dispensed with altogether at this time. A solution of bichloride of mercury in a strength of from 1–30,000 to 1–15,000, in combination with a small amount of glycerin, is about the best routine injection for use at this period. Some cases appear to be materially benefited by it, but in many it will be found to be too irritating and, temporarily at least, harmful. Even in the cases in which it is beneficial, it appears to lose its effect in from two or three to ten days, and it becomes necessary to substitute for it some of the ordinary astringents in mild solution. It is possible that its evil effects are due to a peculiarly destructive influence upon the epithelium. It is always more markedly beneficial in simple than in virulent urethritis.

It has sometimes occurred to the author that astringents often serve to prevent the normal evolution of urethritis by condensing the tissues and sealing up—so to speak—the avenues of germ elimination.

In lieu of the bichloride injection during the increasing stage, an anodyne injection may be given, the following being useful formulæ:

℞ Atropinæ sulph. ..... gr. ij.
Bismuthi subnit. ..... ʒ iv.
Muc. acaciæ,
Aquæ dest. ..... āā ʒ ij.
M. Sig. Shake well and inject three times daily.

℞ Tr. opii. deod. ..... ʒ ij.
Bismuthi subnit. ..... ʒ iv.
Muc. acaciæ,
Aquæ dest. ..... āā ʒ ij.
M. Sig. Shake well and inject three times daily.

℞ Morph. sulph. ..... gr. viij.
Cocainæ. ..... gr. iv.
Muc. acaciæ ..... ʒ i.
Aquæ dest. ..... q. s. ad ʒ ij.
M. Sig. Inject three times daily.

There is no objection to the use of a mild and sedative astringent in combination with the anodynes:

℞ Plumbi acetatis. ..... gr. iv.
Vini opii. ..... ʒ ij.
Aquæ rosæ ..... q. s. ad ʒ iv.
M. Sig. Inject three times daily.

℞ Sodii biboratis. ..... gr. xx.
Morph. sulph ..... gr. vi.
Aquæ rosæ ..... ʒ iv.
M. Sig. Inject three times daily.

In the stationary stage of the affection the strength of the astringent injections may be slightly increased. It would appear that it is not so much the form of astringent as the method of its use that determines the beneficial effects. It will be found that a number of different astringents will give about the same average results when properly used, although in some cases it will be found necessary to vary them. The most popular astringent drug is the sulphate of zinc, and this will be found beneficial in quite a large proportion of cases. Personally the author prefers the sulpho-carbolate or iodide of zinc to the sulphate. The nitrate of silver in a strength of one-eighth to one-half of a grain to the ounce of water is often of great service. Some recommend it as the best routine injection.

The following illustrative combinations will be found to be useful:

℞ Zinci sulphat. (acetat.) ..... gr. xij.
Morph. sulph. ..... gr. x.
Glycerini ..... ʒ i.
Aquæ rosæ ..... ʒ iij.
M. Sig. Injection.

℞ Zinci sulpho-carb..... gr. xvi.
Glycerini..... ʒ i.
Aquæ rosæ..... ʒ iij.
M. Sig. Injection.

℞ Zinci iodidi..... gr. viij.
Ac. carbol..... gr. iv.
Aquæ dest..... ʒ iv.
M. Sig. Injection.

The acetate of lead is also a serviceable astringent.

℞ Plumbi acet..... gr. xx.
Tr. opii..... ʒ ij.
Aquæ rosæ..... q. s. ad ʒ iv.
M. Sig. Injection.

The vegetable astringents are often to be preferred to those of a mineral character. Matico, hydrastis, catechu, kino, and like drugs are very popular, and are dependent upon the tannic acid which they contain. The muriate of hydrastin is especially popular and very often efficacious. A favorite vegetable astringent in the author's practice is the fluid extract of hamamelis virginica. The following formula has proved of great service:

℞ Hydrastin mur..... gr. x.
Ext. hamamelis fl..... ʒ ij.
Glycerini..... ʒ i.
Aquæ dest..... q. s. ad ʒ iv.
M. Sig. Injection.

As the inflammation begins to decline, the strength of the injection selected may be increased, sometimes to double the proportions given. This should be done very cautiously, however, and in no instance should an injection be continued when it is found to produce considerable pain. Nothing more than a slight smarting is warrantable. In some cases the use of the injection does not produce much immediate discomfort, but it is found that smarting during micturition increases. Under such circumstances either the strength of the injection should be diminished or some other form of medicament substituted for it. This proposition is especially pertinent as applied to injection of the bichloride of mercury; it will be found that with this drug in a strength of even one-sixteenth of a grain to the ounce, patients will complain in a day or two, not of pain following the injection, but of severe smarting in micturition.

Sulphate of thallin is often of service in a strength of 20 grains to the ounce of rose-water.

Iodoform has been used to a considerable extent in the treatment

of acute urethritis, but, as far as the author's experience goes, it does not seem to be superior to, or even as efficacious as, many other drugs, and its disagreeable odor more than counterbalances any possible beneficial effects. In the chronic forms of the disease, however, it may be used with advantage, if the patient can be induced to disregard its tell-tale odor.

A form of treatment which has been highly recommended is the insertion of soluble bougies of various types of medication. The author is satisfied that this method of treatment is not only illogical, but is very injurious in acute urethritis, for any suppository of sufficient stiffness to permit of its introduction into the urethra is capable of producing mechanical irritation. As an additional objection, there is no form of soluble bougie which can be practically applied by the majority of patients. There exists, also, the not inconsiderable danger of exciting inflammation of the deep urethra, prostatic and vesical complications, and epididymitis. The author has seen several of these complications in consultation, which he has been inclined to attribute to the use of the bougies, and in experimenting with them in his own practice he has had on several occasions unfortunate results. It is certain that it is impracticable to combine germicide drugs with the bougies in sufficient strength to completely neutralize the virus of the disease, and inasmuch as the bougie necessarily carries with it more or less of the poison into the deeper portion of the canal, it is obvious that an extension of the inflammation is apt to result. The author does not wish to be understood as absolutely condemning the use of soluble bougies, for in the chronic forms of urethritis they are often of service. It must be confessed, however, that even in these cases the bougie is of benefit chiefly through a primary increase of irritation of the canal, as a consequence of the mechanical stimulation which it produces. The author, therefore, rarely uses them, excepting in exceedingly chronic cases in which he considers it necessary to "wake up," so to speak, the inactive mucous membrane.

One of the most popular modern methods of treatment of urethritis is that by retro-injection of hot water or antiseptic solutions through a soft rubber catheter or some of the various forms of tubes devised specially for this purpose. Many of those who have tried this method are very enthusiastic in its praises, but the author is free to say that these surgeons must either have a knack in the application of the method which he has been unable to acquire, or his patients are characterized by very sensitive urethræ. The method is open to the same objections as the use of soluble bougies, for in the introduction of the tube more or less of the virus is carried into

the deeper portions of the canal, and it is questionable whether the injection fluid can be safely given in a strength sufficient to neutralize it. More or less mechanical irritation is induced, and in very acute cases this is likely to be productive of injury. On the other hand, in certain cases which exhibit a tendency to chronicity the irrigation method is decidedly beneficial.

The author has found that a soft, open-ended catheter is as useful as anything for deep irrigation of the urethra. Under ordinary circumstances, and always in acute cases, a short nozzle is sufficient. This is to be used without a urethral tube, and has a concave shield to catch the return flow. There are several varieties of injection tubes which are more or less useful.

The latest fad in the treatment of urethritis is what is termed the dry method. This consists in the introduction of dry antiseptic powders into the canal through a special and patented device. This method is open to the same objections as is the use of soluble bougies and retro-irrigation in acute gonorrhœa. It is apt to be of service, however, in less acute forms of the disease.

Blistering the perineum and penis by means of cantharidal solution is a favorable remedy for acute gonorrhœa with some surgeons. Milton, in particular, favors this method of treatment, but applies the blister in the form of cantharidal plaster wrapped about the penis. The author has found that most patients object to fly-blisters, and has compromised by applications of the tincture of iodine along the course of the urethra with apparent benefit. Milton recommends what he terms a "caustic plug" in the treatment of obstinate cases of gonorrhœa. This consists in a strip of linen, saturated in a five-grain solution of nitrate of silver, which is inserted into the urethra through a tube similar to an endoscope; the latter is then removed, the cloth being allowed to remain until it comes away with the urine.

It is not the writer's purpose to present all of the various methods of treatment and specifics that have been recommended for urethritis. This would be an onerous as well as unprofitable task. The list of specifics recommended runs well into the hundreds. The foregoing is intended only as a practical outline of urethral therapeutics.

Chronic Urethritis.

Chronic urethritis embraces all those various phases of secretion-forming inflammations of the urethra which are generally included under the generic term of gleet. For the sake of accuracy, the latter term—if it be used at all—should be applied with the understanding that it merely implies a symptom, and only to those chronic forms of

inflammation which come on, at a greater or less interval after the acute urethritis is apparently cured, as a consequence of various pathological changes of a chronic character due to the antecedent acute inflammation. It is better, however, to use the term first suggested.

Causes.

The causes of chronic urethritis are as follows:

1. Idiosyncrasy. This consists in this instance of a predisposition to mucous fluxes and catarrhs characterizing certain individuals. This is a particularly important factor in certain climates. The variable temperature and barometric pressure characterizing our lake region are an illustration of this, and seem to have an influence in aggravating and perpetuating urethritis.
2. The gouty and rheumatic diatheses.
3. Dyscrasiæ of various kinds, particularly syphilis.
4. Cachectic conditions resulting from various constitutional diseases of an acute or chronic character.
5. Intemperance in eating and drinking.
6. Improper treatment, involving usually the use of too powerful injections, with resultant destruction of the epithelium of the mucous membrane.
7. Too active exercise during the acute stage of urethritis.
8. Prolonged and ungratified sexual desire.
9. Sexual excesses and masturbation.
10. Privations of various kinds and unhealthy hygienic surroundings.
11. Localization of the acute inflammation at some particular point, with a consequent patch of local disease involving stricture or a granular and congested condition of the mucous membrane. This is the most important factor of all.

It will be observed from a survey of these various causes that the influences which tend to the perpetuation of urethritis are numerous and varied.

Varieties of Chronic Urethritis.

Chronic urethritis presents itself under three different forms:

1. The acute inflammation subsides to a certain extent, but remains subacute, with occasional acute exacerbations accompanied by a thick, purulent discharge for an indefinite period. In this form of chronic inflammation there is continual discomfort, with more or less pain and smarting on urination. Generally, too, the prostate is in-

volved to a certain extent, giving rise to a feeling of fulness and tension in the perineum, with frequent urination.

2. The discharge becomes thin and watery, being sometimes so scanty that nothing is visible save a drop or two of muco-purulent fluid escaping from the meatus in the morning. This is the most frequent form of the disease, and is not usually attended by discomfort. It may depend upon: (*a*) A simple catarrhal condition of the mucous membrane, such cases involving the element of constitutional and local predisposition. (*b*) Congested and granular patches in the mucous membrane. (*c*) Organic stricture. (*d*) Urethral polypi and papillomata. These are very rare conditions, but cases in which polypoid growths were removed through the endoscope are reported by Grünfeld and others. The author has operated several times for urethral papillomata with a resulting cure of obstinate gleet. (*e*) Abscesses or fistulæ resulting from acute urethritis, and becoming chronic. (*f*) Dilatation and pocketing, with chronic inflammation of the lacuna magna. (*g*) Urethro-prostatic catarrh. (*h*) Posterior urethritis, *i.e.*, chronic follicular prostatitis. (*i*) Folliculitis. (*j*) Cowperitis. (*k*) Tubercular infection.

3. In this form of chronic urethritis the inflammation is apparently recovered from, but after a variable period of time, during which possibly the individual does not have his attention called to his urethra, there develops, as a consequence of sexual excesses, intemperance, or the like, a thin muco-purulent discharge.

The distinctive features of the various phases of chronic urethritis are dependent upon differences in the degree of activity of the inflammatory process; such differences do not warrant a distinct differentiation of chronic urethritis and gleet. As a rule, however, the danger of contagion is directly proportionate to the degree of purulency of the discharge. It must, however, be considered in this connection that, as already suggested, it is possible that the discharge of virulent urethritis may lose its purulent and ordinary infectious qualities as far as its capacity for imparting acute vaginitis is concerned, but may nevertheless become transformed in such a manner that it is still capable of setting up various uterine, peri-uterine, salpingian, and ovarian troubles in the female.

Some of the cases of so-called gleet consist in the appearance, under sexual excitement, and almost uniformly on rising in the morning, of a slight, sticky moisture at the meatus. In most of these cases the annoyance produced by the disease is entirely of a mental character. The author is sometimes inclined to think that such patients would experience a feeling of disappointment if they failed to detect on rising in the morning the usual tear of urethral secretion.

The appellation of psychic gleet, although a little far-fetched, would not be inappropriate as applied to such cases. Some of these patients are unable to detect the secretion, except on squeezing the urethra. The pertinacity with which such individuals will vigorously "milk" the urethra for the purpose of exhibiting a drop or two of mucus as an evidence of their alleged deplorable condition is worthy of a better cause. Probably fifty per cent. of these cases are kept up by this pernicious practice. Most individuals, upon being questioned, will acknowledge that they are in the habit of seeking for the discharge a number of times daily, and they are considerably surprised when informed that their enthusiastic search for something that they do not wish to find, is mainly responsible for their woes. The pathological condition in this variety of gleet is simple hypersecretion of mucus by the follicles of the urethra. The author is convinced, moreover, that quite a proportion of cases in which the discharge is more pronounced are dependent upon a catarrhal state of the mucous membrane, with a coincident hypersecretion of mucus, as a result (1) of habitual over-stimulation of the glands and (2) of their enlargement.

The discharge in most cases is thin, rather watery, and of a whitish color. It becomes thick and yellowish, however, under the influence of the various causes enumerated as productive of chronic urethritis. A patient suffering with gleet is continually liable to acute exacerbations of his urethral difficulty upon the occurrence of the slightest exciting cause. The origin of the discharge, in cases in which no local lesion of the urethral mucous membrane can be discovered, is the numerous mucous follicles lining that portion of the urethra corresponding to the site of the chronic inflammation. There is more or less epithelium mingled with the discharge, and it will be found that one of the characteristic features of gleet is a rapid formation and removal of the delicate epithelial cells lining the urethra. This is particularly pertinent as applied to those cases of chronic inflammation dependent upon chemical or traumatic interference with the canal, such as is afforded by strong injections and injudicious instrumentation. When congested, granular, or abraded patches exist in the course of the canal, there is a constant hypersecretion of mucus or muco-pus, with exfoliation of the epithelium upon the surface of the lesion. In this condition, as well as in stricture, the current of urine, as it passes over the diseased portion of the canal, rolls up into strings or threads the desquamated epithelium and muco-purulent deposit upon the surface of the diseased membrane. These strings appear in the urine as the delicate thready filaments—*Tripper-faden*—which, as every practical surgeon is well

aware, are almost invariably indicative of urethral disease. The majority of surgeons attribute this appearance of the urine to stricture, but this is a mistake, for it will be found in many cases in which stricture cannot be detected, and is in such cases dependent upon urethral catarrh and general desquamation of epithelium. In stricture a condition of chronic inflammation exists posterior to the narrowing of the canal; as a consequence of obstruction at this point there is more or less pouching of the urethra at the posterior surface of the stricture. This dilated portion of the canal loses its elasticity and contractility, and, as a consequence, forms a more or less passive pouch upon its floor, in which a drop or two of urine almost invariably remains and decomposes. As a consequence of this decomposition, the inflammation and consequent muco-purulent secretion are enhanced. It is from this point that the gleety discharge and thready urinary filaments characterizing stricture are derived.

The author desires to emphasize particularly the influence of powerful injections in the production of chronic urethritis. He has had a number of cases come under his observation in which the patients had used powerful solutions of carbolic acid, sulphate of zinc, permanganate of potassium, etc., in the early stages of urethritis, and in the majority of these cases he has had an endless amount of trouble in curing the disease. The obstinacy of such cases is undoubtedly dependent upon chemical destruction of the epithelium lining the canal. This, being repeated from day to day, eventually results in a permanently abraded condition of the entire mucous membrane, which necessitates the rapid proliferation of epithelium for the purpose of repair; this epithelium being, however, of a low grade and, moreover, governed to a certain extent by the influence of physiological habit, is thrown off as rapidly as formed, and, as a result, the canal remains in a perpetually raw and inflamed condition. It is by no means necessary that injections should be acutely painful when used to accomplish this untoward result.

Still more important factors in the production of chronic urethritis are intemperance and faulty sexual hygiene. The use of alcohol predisposes all of the tissues of the body to inflammatory processes, this being particularly true of the mucous membranes, which become highly irritable; it has, moreover, a special effect in overstimulation of the sexual apparatus, both through the medium of the nervous system and more directly by the production of irritating properties in the urine. The majority of individuals contracting urethritis are more disturbed by the interruption of their customary fornication than by any immediate or remote danger or inconvenience produced by the disease. They are possessed also with the

fatuitous idea that any form of sexual stimulation short of actual intercourse is not injurious; as a consequence, they associate intimately with women of loose character, whom they can caress and take liberties with, and, as a result, keep the sexual system in a constant state of excitement. This is fully as disastrous in its effects as natural sexual indulgence, if, indeed, it is not worse. As soon as our patients are satisfied that a discharge no longer exists, or, in many instances, as soon as the discharge has greatly diminished in quantity, they begin their sexual indulgences. They come to us in the fault-finding manner of the average venereal patient, and ascribe the unfavorable progress of the urethritis to improper treatment; seldom will they acknowledge sexual excitement or indulgence, or the use of alcoholic beverages. Were it not for the sexual and alcoholic elements in the production of gleet, the author is satisfied that comparatively few cases of urethritis would last over six or eight weeks.

A lack of rest is another important element favoring chronic urethritis. In every case of virulent inflammation in which the patient is so situated that he is compelled to be on his feet the greater part of the time, to walk about or indulge in muscular strains, lifting, etc., we may expect a stubborn course of the disease. As a corollary, it is to be inferred that patients enjoying facilities for comparative quiet will recover promptly in the majority of instances.

Duration.

The duration of chronic urethritis is very uncertain; it depends mainly upon the curability of the various pathological conditions of the canal upon which the perpetuation of the chronic urethral inflammation depends. In some instances, a complete cure is impossible, judging by the frequency with which cases are encountered that have undergone every known method of treatment for a number of years without success. The author ventures the opinion that, in such an environment as our lake region, catarrhal urethritis is more apt to persist indefinitely than in other localities.

Some cases of alleged gleet cannot be cured simply because of the pertinacity with which the patient clings to the idea that he is in a serious condition, over-treatment being the most natural result. One meets with numerous cases in which the patient is practically cured, but in which it is impossible to convince him that such is the case. These cases of psychopathic gleet go from surgeon to surgeon, vainly seeking a cure for something which does not exist.

Too prolonged and energetic treatment is often responsible for the

perpetuation of gleet. Many cases are observed in which improvement occurs only upon complete cessation of treatment.

Cases of gleet are occasionally seen that defy all measures of treatment.

Treatment.

The treatment of chronic urethritis requires more radical measures than are warrantable in the acute stages of the affection, and incidentally a greater variety of remedies, these being necessitated by the varying character of the special causes which tend to the perpetuation of the inflammation.

The first step to be taken is to explore the urethra, and thus determine, if possible, what particular local condition is keeping up the difficulty. For ordinary purposes the bulbous, flexible French bougies will be found to be all that is necessary for this purpose, for in the majority of instances a knowledge of the existence of a localized spot of inflammation or stricture is all-sufficient, ocular inspection being of little or no advantage. In the hands of the expert the bulbous bougie readily determines with a great degree of accuracy the condition of the urethra. Otis' acorn-tipped metallic sounds may be used, but the soft instruments are preferable.

The endoscope bears a somewhat similar relation to urethral exploration that the stethoscope does to the diagnosis of disease of the thoracic viscera. The physician who becomes expert in physical diagnosis finds that the unaided ear is all-sufficient for practical purposes in the exploration of the chest, the stethoscope becoming necessary only in very obscure cases, or those in which critical and hair-splitting differentiation of objective signs becomes necessary. There have been numerous elaborate endoscopes devised, but for practical purposes the ordinary straight, hard rubber or silver tubes, with the addition of a strong light reflected from a laryngoscopic reflector, or from one of the modern small reflecting electric lamps, are sufficient. The panelectroscope of Leiter is valuable where it is practicable to utilize it. The author has found that his own endoscopic tubes, which are much larger than Leiter's, are more useful than the latter in most cases in which he uses the panelectroscope. It is well to have a series of these tubes, in order that an instrument may be selected which is as large as the capacity of the urethra will permit.

In case stricture exists, preliminary dilatation may always be practised prior to endoscopy, and it thus becomes possible to use relatively large tubes for explorative purposes. The mistake is often made of having these tubes made too long; by crowding the

penis well down around the tube, a short tube can be used much more effectively than larger ones.

We will first consider those cases the chronicity of which depends chiefly upon constitutional conditions or a general predisposition to catarrhal fluxes of various kinds, and in which exploration fails to detect any local condition that will explain the discharge. Cases frequently arise in which all forms of internal and local treatment fail of their object because of inappreciation of the constitutional peculiarities of the patient. Debilitated and strumous subjects, and those who are cachectic from any cause whatever, require the administration of tonics, such as quinine, iron, cod-liver oil, and various preparations of nux vomica. In cases of this kind the tincture of the chloride of iron or the mineral acids sometimes accomplish wonderful results by improving the general systemic condition, toning up the relaxed and flabby mucous membranes, and inhibiting excessive secretion. It is in these cases, too, that we are apt to have excellent results from the internal administration of vegetable astringents, ergot, etc. Turpentine in moderate doses is occasionally of decided advantage to these patients; the tincture of cantharides may also be of service.

Local measures of treatment are often unnecessary. In fact, it will be found that it is in just such patients that the prolonged use of injections and balsamic preparations are inclined to perpetuate the gleet. In some instances, however, in conjunction with measures to improve the general health, it will be found advantageous to make local applications. One of the best preparations is the pure fluid extract of hamamelis, applied by a cotton-wrapped probe through the endoscopic tube. This will never be found to be too strong, and it is a singular circumstance that patients who are unable to bear an ordinary injection, in the strength of one part of hamamelis to four of water, make no complaint of the application of the pure fluid extract in this manner. It is sometimes necessary to alternate the applications of this astringent with the use of an ointment of nitrate of silver, ten grains to the ounce, in combination with stramonium or belladonna, by means of the cupped sound. Tannin may be used in the same manner. In making all these applications the patient should first be directed to urinate; a full-sized sound should then be passed to press out the contents of the dilated follicles of the urethra, after which the medicated application is made.

A plan which has proved efficacious in some instances is the prolonged use of hot water in combination with the acetate of lead, the patient being instructed to inject the urethra for fifteen or twenty minutes, night and morning, with water as hot as can be borne. The

treatment is to be concluded by syringing the canal with fifteen drops of a saturated solution of the acetate of lead in an ordinary teacupful of hot water. This is to be thrown into the canal four or five times in succession. In a few instances of catarrhal gleet the author has succeeded in checking the discharge by the use of a watery solution of ordinary alum, in the strength of a drachm to eight ounces, night and morning.

It may be considered absurd to advocate a change of climate for patients with this form of chronic urethritis, yet, when the general condition seems to demand it, this plan may be advised, and will be found to be productive of marked benefit.

The rheumatic, gouty, syphilitic, and tubercular diatheses will be found to be responsible for some cases of chronic urethritis. These conditions require the same remedies as under other circumstances; the combinations of mercury, iodide of potassium, and colchicum are apt to be particularly serviceable in the three former conditions. The various balsamic preparations may be continued during the course of treatment for chronic urethritis, providing the stomach and kidneys are tolerant of these drugs.

Stricture of the urethra is the most frequent cause of chronic urethritis. Its treatment will be considered in a subsequent section.

Congested and granular patches require local applications by means of the endoscopic tube. It should be remembered in this connection that general and powerful applications to the canal are apt to be productive of injury. It is an unfortunate fact that the surgeon seldom localizes his efforts to cure the complaint, but continues the use of caustic and astringent applications, "shot-gun" fashion—sometimes hitting the disease, but more often the normal membrane—and the internal administration of the balsams, in a futile effort to relieve something that perhaps a single well-directed application would cure. It is necessary to determine the precise location of the offending spot and to measure accurately its distance from the meatus, with or without ocular inspection of the part. The passage of a steel sound upon alternate days for a few weeks will cure a large proportion of these cases by crushing the minute granulations, emptying pus-distended follicles, producing local absorption of the infiltrated material in the mucous membrane, toning up the latter, and stimulating repair. When this method of treatment has been proven to be ineffectual, strong applications of the nitrate of silver or the sulphate of copper may be made directly to the diseased spot through the endoscope. The pure crayon of sulphate of copper or nitrate of silver is safe, if very cautiously used. The silver may be fused upon the end of a blunt probe and touched to the spot very lightly. In

lieu of the pure caustic, strong solutions of copper or silver may be used, thirty to sixty grains to the ounce being admissible, but great care is necessary not to leave an excess of the caustic fluid upon the mucous membrane. When the diseased point is within three inches of the meatus, the urethral speculum is often serviceable in making applications. The meatoscope may also be useful. It is in cases of chronic urethritis that the methods of treatment by soluble bougies and retro-injection are apt to prove of the greatest service.

One of the oldest methods of treatment of gleet consists in the injection of astringents of gradually increasing strength. Thus Ricord's old formula consists in the injection of one part of red wine to three of water, each syringeful of the injection being replaced by wine, so that after a time the patient is using the pure red wine. Bumstead speaks highly of strong solutions of the persulphate of iron.

Experience has shown that many cases of urethritis are perpetuated by a contracted meatus, behind which urine and inflammatory products accumulate and produce irritation. It is advisable to perform meatotomy as a matter of routine in every case of chronic urethritis in which the meatus will not admit a full-sized sound. The incision should be made with a straight blunt-pointed bistoury and kept open by the frequent introduction of a short sound or a fossal bougie.

In some cases of gleet, dependent upon congested and granular patches of mucous membrane, there exists a slight thickening of the underlying mucous membrane, hardly of sufficient importance to be denominated a stricture, yet requiring the same treatment, and eventually terminating in a constriction of the lumen of the canal. These patches of tough and resilient infiltration are usually found in the pendulous portion of the urethra, and in such cases the gleet is absolutely resistant to all measures of treatment, until a urethrotomy is made and the thin layer of thickened tissue divided. When this process extends entirely around the circumference of the canal, it necessarily constitutes a stricture of large calibre, but it is well to remember that the relation of the thickened tissue to the gleet is precisely the same in those cases in which, on account of the circumscribed limitation of the process, no pronounced narrowing of the canal is evident, as it is in those in which an acknowledged stricture exists. It is to be remembered, furthermore, that in many cases which are denominated "stricture of large calibre" there is really not a strictured condition of the canal, but as the instruments pass over a thickened, granular, and hyperæsthetic patch there occurs, just at the location of the lesion, spasm of the accelerator urinæ and compressor urethræ muscles, which gives rise to the same objective

symptoms as stricture. It is probable that urethrotomy is performed many times for the relief of strictures of large calibre in which true organic stricture does not exist, and there is only the condition of affairs just described to explain the obstruction to the introduction of instruments and the grasping of the bulbous bougie as it is withdrawn from the canal. This fact, however, is no argument against the necessity for urethrotomy.

In a few cases of chronic gleet the author has obtained marked benefit by the use of astringent sprays thrown through the endoscopic tube by means of an ordinary Sass spray apparatus, in alternation with applications by means of the powder-blower of an impalpable powder of iodoform, boracic acid, and camphor in equal parts.

When the inflammatory process has extended to the deep or prostatic urethra, deep injections by some method or other are absolutely necessary. The instrument of Ultzmann or its modifications may be used for this purpose. The author has devised a more capacious syringe than that of Ultzmann, which he prefers to any he has seen. Nitrate of silver, sulphate of copper, and sulphate of thallin are the best drugs for use in these cases of deep inflammation. Soluble prostatic bougies and astringent ointments are occasionally of great service in posterior urethritis, *i.e.*, follicular prostatitis.

As far as his own experience goes, the author has found the sulphate of thallin in a fifteen to twenty per cent. solution the best antiseptic and astringent application for routine use in the posterior urethra. His usual plan is to alternate the thallin with irrigations of nitrate of silver or potassium permanganate in varying strength. In some cases in which there is chronic inflammation of the bulbous urethra we may succeed in exciting healthy action by irrigating the canal with hot iodized water of the strength of one drachm to the pint. In quite a number of obstinate cases the author has had excellent results from the use of a mixture of balsam of Peru, compound tincture of benzoin, and iodoform introduced through the endoscopic tube:

℞ Iodoformi..... ʒ iv.
Tincturæ benzoini compositæ,
Balsami peruv.....āā ℥ i.
M.

The following is also useful applied in the same manner:

℞ Iodi resub..... gr. xx.
Eucalyptol..... ʒ ij.
Potassii iodidi..... ʒ ij.
Glycerini tannat..... ℥ ss.
Ac. carbol..... gr. xx.
Boroglyceride.....q. s. ad ℥ ij.
M.

All measures of treatment of chronic gleet will fail if the surgeon does not advise his patient against various sexual, dietetic, and other general causes of perpetuation of urethritis, and if the patient does not follow these instructions to the very letter. It is an unfortunate fact that the average patient with chronic urethral disease lays the responsibility of his case upon the shoulders of his surgeon, and expects a cure to be accomplished without the slightest co-operation upon his own part. The capacity for deceit on the part of the average patient with chronic urethral disease is something astonishing. It is certainly a discouraging thing to have a patient present himself with an acute or subacute urethritis a month or six weeks after he has apparently been cured of stricture and gleet, and have him solemnly vow that he has not played the glutton or *roué* during that time. It is possible that a few such patients do not lie to the doctor, but it would be difficult to convince the expert that, in the absence of an exciting cause, a canal which had been thoroughly dilated and the secretion of which had been entirely checked could spontaneously lapse into an inflammatory state at so long a period after an apparent cure. It is possible that patients with sexual difficulties are no more deceitful than those who present themselves for the cure of other affections, but such is not the impression that the surgeon is likely to derive by observation of such cases. It might be supposed that the average individual has sufficient respect for his own physical interests to be perfectly frank and honest with his physician, and it has been aptly said that "the man who deceives his doctor is a fool." But, as far as his experience goes, the writer is inclined to believe that, if this proposition be true, imbecility is largely prevalent in our community. Whether the moral turpitude of the venereal patient is due to a sense of shame, akin to that which impels him to apply the water-closet theory to the origin of his disease when he is well aware of its true origin, or to a desire to lessen his financial responsibility to his surgeon, is a question that it would be difficult to answer. To say the least, it is safe to assume that there is no class of patients so aggravating as those met with in genito-urinary practice.

Treatment of the Complications of Urethritis.

It is necessary to say a few words regarding the special treatment of the complications of urethritis.

Severe Chordee and Urethral Hemorrhage.

This is best controlled by the administration of the anaphrodisiac remedies already recommended and the application of the cold-water

coil or balloon-rubber ice-bag. The danger of hemorrhage is lessened by the proper management of the chordee. When severe bleeding does occur as a consequence of rupture of the corpus spongiosum from forcible straightening of the penis, it may be controlled in most instances by the cold-water coil. If this is unsuccessful, a gum catheter may be passed into the urethra beyond the point of rupture, and the cold-water coil wrapped tightly around the penis; the injection of astringents into the canal might possibly become necessary if the hemorrhage proved obstinate. The oil of turpentine internally is often of the greatest service in urethral hemorrhage.

Folliculitis and Peri-Urethral Phlegmon.

These conditions are best treated upon conservative principles in the majority of cases. As soon as either of these complications manifests itself, injections and all stimulating methods of treatment should be stopped, and, if possible, the patient should be kept perfectly quiet. Hot applications will usually bring about resolution of the swelling after a time. Some cases are very stubborn, but, as a rule, the little tumors characteristic of folliculitis become absorbed; sometimes, however, they remain as small circumscribed indurations, and appear to keep up irritation. Under such circumstances they may be excised. Excision is recommended by some authorities as a routine practice, under the supposition that the tumors inevitably suppurate, and that there is great danger of rupture into the urethra, followed by extravasation of urine, etc. The author thinks, however, that, as a rule, when the inflammation of the urethra subsides to such an extent that the duct of the follicle becomes patent, the little tumor discharges its contents into the canal and the wall of the follicle eventually shrinks down to its normal size; this discharge of its contents being usually evidenced by a sudden increase in the urethral discharge. The follicles may refill and again discharge an indefinite number of times and cause a succession of re-infections of the canal. Should the swelling be marked or painful, or if fluctuation be evident in peri-urethral phlegmon, an incision must be made at once; this has not been necessary, however, in quite a number of cases which the author has seen. Conservatism, it is true, may be carried too far, but it is presumed that the intelligent surgeon will know when to cut, there being perhaps more danger in delay than in early incision.

Conservatism is not so applicable in case of peri-urethral phlegmon in the perineal portion of the urethra as in cases the involving the pendulous portion of the canal. When the perineum becomes hard

and brawny, it is best to make an early incision, the operation being in itself harmless. If in such instances an abscess has formed and opened into the urethra before the patient has come under observation, the case should be carefully watched and free incisions made. If at any time a marked increase in the perineal swelling, chills, hectic and general constitutional disturbance should occur, as evidences of new purulent foci or urinary infiltration, or if the swelling in the perineum is extensive and there is a disposition to pointing of matter at any particular spot, external perineal section is required. In such cases a fistula results that is likely to heal spontaneously, but may require surgical attention later on.

Retention of Urine.

The conditions producing the retention are to be considered carefully in deciding upon its treatment. In a given case occurring in the course of a gonorrhœa, we must remember that the factors in its production are several, viz., (1) inflammatory swelling of the mucous membrane and consequent diminution of the calibre of the urethral tube; (2) irritation produced by the acid urine; (3) prostatic congestion; (4) muscular spasm. In patients who have suffered from previous attacks there may be a stricture, to which the foregoing factors are superadded as plus conditions. A prostatic abscess may be present, causing retention by simple pressure; this is immediately relievable by incision.

The indications for treatment are plain: sedatives, derivatives, antispasmodics, alkaline diluents, and rest comprising the main features.

A full dose of morphine hypodermically or per rectum, and a hot sitz-bath, to be repeated as occasion demands, are of immediate necessity. Ice in the rectum sometimes assists in relieving local congestion. Leeches to the perineum and anus are often very valuable. Hot drinks of demulcent infusions are of service as adjuvants. If abscess exists about the prostate, an incision is necessary.

An injection of cocainized oil into the urethra may be of service. The dread of painful micturition and the reflex effect of the irritating urine is often an important factor in the etiology of retention; the cocaine may relieve this. The catheter should be used only as a last resort. It is far better, in the author's opinion, to tap above the pubes than to use the catheter, other things being equal. If for any reason it is decided to use the catheter, an anæsthetic should generally be given; cocaine, however, may be used. The greatest gentleness should be exhibited in the passage of the instrument. Before

passing it, the urethra should be thoroughly and deeply flushed with a mild, warm antiseptic solution. By these means we may be able to avoid infecting the deep urethra and bladder. In the author's experience, instrumental interference has rarely been necessary.

Prostatitis.

The treatment of prostatitis is considered in the article on Diseases of the Prostate.

Cowperitis.

Cowperitis requires rest, the application of leeches, and the prolonged use of hot applications. Should the perineum become tense and brawny, or should there be severe pain or retention of urine, an incision must be made into the swelling without waiting for the formation of pus. If at the end of a week or ten days improvement does not occur, an incision is warrantable in any case. It will be found, however, that in many instances the inflammatory process will resolve without the formation of pus, particularly if the cellular tissue of the perineum is not extensively involved. Cowperitis is not always the result of gonorrhœa. The author has seen a typical case of the disease in a tuberculous patient, who had no urethral difficulty. In this instance the trouble appeared to be due to a violent strain, and was probably not of a true tubercular nature, inasmuch as the cavity healed speedily and perfectly after incision, and no other foci of infection appeared. Even if allowed to break spontaneously, the pus in cowperitis usually appears externally. It may, however, open into the urethra and result in the formation of fistula or infiltration of urine, abscess, and sloughing.

Acute Cystitis.

The indications for treatment in this complication of urethritis are simple and exceedingly plain. Rest, a milk diet, anodynes per rectum, per os, or hypodermically, hot sitz-baths, hot rectal irrigation, saline laxatives,—with or without mercurials,—alkaline diluents, plenty of pure water, and demulcent drinks comprise the principal therapeutic resources in this disease. Hot fomentations, turpentine stupes, or poultices over the hypogastrium are often serviceable in general cystitis.

The list of drugs for internal administration comprises such preparations as pichi, kava-kava, uva ursi, cubebs, sandalwood oil, pareira brava, triticum repens, linseed, and slippery elm. Some of these medicaments are available only in the form of infusion, others

in that of fluid extracts. Acetate of potassium, citrate of potassium, benzoate of sodium, liquor potassæ, salol, boracic acid and salicylate of sodium are all serviceable drugs for their antacid, antiseptic, and soothing effect upon the inflamed mucous membrane.

Epididymitis and Orchitis.

The most important indication in the treatment of acute inflammation of the testis is to put the patient absolutely at rest. All stimulation of the urethra by balsams, injections, and irrigations should cease. In some instances, however, the balsams may be given if they are found to be soothing to the inflamed membrane. Hot sitz-baths, twice or thrice daily, should be prescribed. An absolute milk or other unstimulating diet should be adhered to. Alkalies internally are always in order. The author has found salicylate of sodium to be of especial advantage in some of these cases; where the pain, fever, and nervous disturbance are marked, phenacetin or the bromides may be combined with the salicylate. It has occurred to the author that underlying many of these cases of acute inflammation of the testis a rheumatic or gouty diathesis exists as a predisposing cause. Under such circumstances the action of the salicylic acid can be very readily explained. Whether this supposition be correct or not, free salicylic acid and its compounds will often be found to be extremely efficacious. Pulsatilla is occasionally beneficial, but its range of application is apparently more limited than its enthusiastic advocates seem to believe. The suggestion originally made by Dr. Piffard to give the drug in almost homœopathic doses seems to be unsound. After considerable experimenting, the author has concluded that while the drug is more or less efficacious, it must be given in doses sufficiently large to secure a certain degree of physiological effect. Gelsemium in combination with the bromides has appeared to be of special advantage in allaying irritability of the affected structure. Mercurial and saline cathartics are always indicated. Opium should be administered, if necessary, to control pain. The local measures of treatment are by far the most important.

Narcotizing the testis by means of tobacco and linseed-meal poultices, originally recommended by the late Dr. William H. Van Buren, constitutes the most efficacious local application that can be made. When the inflammation is very acute and the pain severe, four or five leeches applied to the scrotum will be found to be of incalculable benefit as a preliminary to other local measures of treatment. The testis should be supported by a pillow or roll of gauze between the thighs so as to avoid the injurious influence of gravity.

Scarification of the scrotal veins, the bleeding being subsequently encouraged by warm fomentations, is very often beneficial. When the pain is severe, and marked acute hydrocele exists, Vidal's method of subcutaneous puncture of the tunica vaginalis sometimes relieves the symptoms almost magically. It has been the author's experience, moreover, that cases treated in this manner terminate much more rapidly than those in which less radical measures have been instituted. In case the testis proper is primarily or markedly involved, the question of subcutaneous incision of the tunica albuginea for the purpose of relieving tension must receive due consideration. Where it is inconvenient to apply poultices, the author has found the application of the following narcotic and sedative ointment to be very efficient:

℞ Menthol..... gr. xl.
Ext. belladonnæ..... gr. xx.
Ext. aconiti..... gr. x.
Lanolin.....q.s. ad ʒ ij.
M. Sig.: To be spread on lint and continuously applied to the testicle.

It may be changed two or three times in the course of twenty-four hours. As soon as the tenderness in the testis has sufficiently subsided, strapping the affected organ may be advisable. Great care is necessary in determining the precise period at which it is safe to begin strapping the organ, as gangrene of the testis has been known to occur from premature or careless strapping. It is advisable not to employ this method of treatment unless the patient is so situated as to be readily accessible to the surgeon.

The internal use of mercury and the iodides and the local application of the faradic current are of great value in procuring resolution where the inflammation shows a tendency to become chronic. It is the author's opinion that counter-irritation, electricity, and alteratives should be employed in practically every case after the subsidence of the acute symptoms, for the purpose of preventing as far as possible permanent induration and occlusion of the epididymal tube.

Gonorrhœal Rheumatism.

The treatment of this complication is not especially satisfactory, being of a palliative rather than a curative character. The treatment for the urethritis should usually be persisted in, for, as a rule, the sooner the local condition improves, the sooner the rheumatic complication will yield. If, however, the discharge has ceased, it is best to let the urethra severely alone. When patients

are debilitated, tonics, such as strychnine, quinine, iron, arsenic, and cod-liver oil are of advantage. The skin and bowels should be kept active and elimination favored by the use of pilocarpine hypodermically. Pain should be relieved by the use of opiates; hot applications and fixation of the inflamed joint are essential for the same purpose. Should the knee be involved, Buck's extension apparatus should be applied as in ordinary forms of arthritis. The application of fifteen or twenty leeches to the joint will often prove serviceable. Flannels wrung out of hot water and sprinkled with turpentine form a useful application to the inflamed joint. As the inflammation subsides, blisters or iodine will be found to promote resolution. Mercury and iodide of potassium internally are of great service in the chronic stage of the disease. The author has had excellent results from intra-articular injections of iodoform emulsion. It is well in all cases to try the effect of the salicylates, inasmuch as the rheumatic or gouty diathesis may exist as a predisposing cause of the disease. The more important joints, such as the knee, are best treated by the plaster-of-paris bandage as soon as the acute inflammation has subsided. Passive movement, and perhaps measures to break up ankylosis, are required in the later stages of the affection. Turkish and electric baths, static electricity, friction and massage are serviceable adjuvants. Static electricity is particularly beneficial. The author has been much impressed with the value of this remedy in neglected cases of chronic enlargement of the joints. During the acute stage of gonorrhœal rheumatism a milk diet is very essential.

The ocular complications of gonorrhœa belong to the province of ophthalmology, and their treatment does not concern us here.

Bubo.

The slighter forms are curable by limiting movement and the application of iodine. In the more marked forms the patient should take to bed and apply hot linseed-meal poultices, sprinkled with laudanum, every two hours. The hot poultice is the best pus prophylactic at our command. Should resolution not occur promptly, extirpation of the enlarged glands is indicated. If we operate aseptically, before peri-adenitis and infection of the surrounding tissues have occurred, and close the wound accurately, healing is quite prompt. This may seem radical, but the author has become thoroughly disgusted with the tiresome method of waiting for a bubo to suppurate, and then waiting for weeks or months for it to heal. If prompt healing does not follow a radical operation, the part is still

in much better shape for subsequent granulation and cicatrization than if a distinct abscess be allowed to form.

Balanitis and Vegetations.

Circumcision will prevent balanitis in cases of redundant and phimosed prepuce. In default of circumcision, absolute cleanliness may prevent balano-posthitis. When this complication comes on, the indications are to keep the parts clean and dry. Astringent and antiseptic lotions and absorbent powders are useful. The iodide, sulphate, or acetate of zinc, alum, bichloride of mercury, permanganate of potassium and many other drugs are serviceable in mild solutions. Finely triturated bismuth, calomel, lycopodium, oxide of zinc, and oleate of zinc are valuable. The last-named drug is perhaps the best of all, if a good preparation be used. The stearate of zinc is another elegant preparation. Severe balanitis may require a dorsal incision of the prepuce to expose the parts for inspection and treatment.

Vegetations should be cut away with the scissors and their bases cauterized with fuming nitric acid. Cleanliness, dryness, and perhaps circumcision, are necessary to avoid their recurrence. The same principles of treatment should govern here as in balanitis.

STRICTURE OF THE URETHRA.

Stricture of the male urethra is by far the most important of all the surgical diseases of the genito-urinary apparatus. It is of importance not only because of its extreme frequency, the special condition which most often gives rise to it affecting sooner or later a large proportion of male humanity, but because of its important relations to secondary pathological conditions of organs more vital than the structure primarily affected.

Stricture of the urethra may be defined as an abnormal diminution of the lumen of the canal at one or more points or throughout its entire course, due to any cause whatsoever, whether temporary or permanent. It may arise from any of the following conditions:

1. Pressure from without, due to (*a*) neoplastic formations; (*b*) extravasations of blood or urine from injury; (*c*) purulent collections and infiltration; (*d*) fracture of the pelvic bones.

2. Spasm of the muscles in and about the urethra, due to (*a*) direct irritation by lesions of the canal; (*b*) direct or reflex irritation from foreign bodies in the canal; (*c*) reflex irritation from more or less remote pathological conditions; (*d*) the introduction of instruments;

(*e*) emotional excitement; (*f*) malaria(?); (*g*) highly acid and concentrated urine, and occasionally oxaluria and gravel.

3. Congestive or inflammatory engorgement of the urethra, due to (*a*) acute urethritis; (*b*) traumatism of the urethra; (*c*) inflammation in and about organic obstructions.

4. Thickening of the urethral walls, due to (*a*) congestive and granular patches in the mucous membrane, *i.e.*, superficial infiltration from chronic inflammation; (*b*) plastic infiltration and formation of connective tissue in the meshes of the corpus spongiosum from severe and long-continued inflammation; (*c*) cicatricial deposit in the corpus spongiosum and urethral walls incidental to traumatism; (*d*) cicatricial deposit due to the action of various caustics and powerful irritants; (*e*) cicatricial deposit following ulceration or sloughing produced by the impaction of foreign bodies.

5. Deficient elasticity of the urethral walls and corpus spongiosum: (*a*) From congenital sparsity of elastic and muscular fibre and a preponderance of fibro-connective tissue; (*b*) from inflammation.

6. Congenital narrowing of the urethra, or slight atresia from defective fœtal development.

7. Polypi of the urethral mucous membrane.

Varieties.

From a clinical standpoint, strictures may be divided according to their origin into: (1) Spasmodic; (2) congestive or inflammatory (circumscribed or general); (3) organic or fibrous (permanent), *i.e.*, neoplastic.

Those varieties of stricture, the nomenclature of which depends upon real or supposed differences in the condition producing the obstruction, are not always to be differentiated clinically because of the fact that the several conditions may coexist in varying proportions in any given case of the disease. Thus inflammatory or congestive narrowing of the urethra, although sufficient *per se* to produce obstruction in some cases, is nearly always complicated by spasmodic narrowing of the canal. Simple spasmodic stricture is relatively rare, occurring only as a result of reflex irritation, of mental impressions, or of instrumentation when the urethra is very sensitive. On the other hand, spasmodic stricture dependent upon acute or chronic organic changes in the urethral mucous membrane is very frequent. Again, there are few cases of organic stricture that are not complicated at one time or another by inflammation, congestion, or muscular spasm; in fact, all of these elements, which the author would term plus conditions, and particularly spasm, are apt to require attention at various times during the treatment of organic stricture.

Spasmodic Stricture.

Spasmodic stricture—or, as it may justly be called, pseudo-stricture—may be defined as a diminution of the calibre of the urethra, due to spasmodic contraction of the muscular fibres in and about the walls of the canal. This contraction may produce complete retention as a result of such exciting causes as acid urine, intemperance, or sexual indulgence.

Spasmodic stricture is merely an intensification of the physiological function of the cut-off, accelerator urinæ, and compressor urethræ muscles, in which, from various sources of irritation, the muscular fibres are spasmodically contracted and the volitional power of the patient over the act of urination is for the time being held in abeyance.

The site of spasmodic stricture varies. There are almost always two points of spasmodic contraction: (*a*) At the point of irritation, and (*b*) in the musculo-membranous urethra.

1. When a foreign body is introduced into the canal, the urethra resents the liberty at any point of irritation, and there occurs simultaneously with a slight contraction at the point irritated, a reflex spasm of the cut-off and urethral muscles. The same is often true in cases of organic stricture in the penile portion of the urethra or at the meatus. This is an important practical point, for it has been established that, simultaneously with the removal of an anterior point of obstruction and irritation, a supposed deep organic stricture often disappears.

2. The entire canal may be spasmodically contracted and resent the introduction and withdrawal of instruments.

3. The musculo-membranous region may alone be involved. This happens in cases in which an organic lesion exists in the deep urethra and in those in which spasm is due to reflex causes.

The causes of spasmodic stricture may be classified as:

1. *Predisposing Causes.*—(*a*) General hyperæsthesia; (*b*) local hyperæsthesia. Both of these causes are modified by a nervous temperament, debilitated and cachectic states of the system, the rheumatic and gouty diatheses, intemperance, high living, faulty sexual hygiene, etc. (*c*) Acute or chronic disease of the urinary organs. This is the most frequent predisposing cause, and it is rarely indeed that a case of spasmodic stricture is met with in which a more or less damaged state of the canal does not exist. So uniformly is it present, that it is always to be suspected until organic disease has been excluded by exploration. Congested and fungating patches, erosions of the mucous membrane, acute and chronic urethri-

tis, and organic stricture of whatever degree, constantly predispose to spasmodic contraction, both at the point of irritation and at the cut off muscle; such predisposing causes are always effective in its production during the passage of an instrument. A congenital narrowing of the meatus or other parts of the canal may give rise to reflex spasm of the deep urethral muscles in any case in which an instrument is passed, of a sufficient size to produce stretching of the sensitive tissues at the point of contraction. As already noted, when instruments are introduced under the pathological conditions alluded to, there is a spasm at the site of the lesion and another deep down in the canal.

2. *Exciting Causes.*—1, Passage of instruments; 2, sexual excitement or excess; 3, injury to the canal—chemical or traumatic; 4, a debauch; 5, cold-taking; 6, foreign bodies; 7, drugs, such as cantharides and turpentine; 8, reflex irritation; 9, malaria (?); 10, mental emotions.

A survey of the various exciting causes of spasmodic stricture is sufficient to indicate the fact that in nearly all instances the element of spasm is associated with congestion and inflammation—conditions which such special causes are most apt to excite. Spasm due to drugs is usually associated with considerable inflammation and attended by frequent and painful micturition (strangury), perhaps associated with urethral hemorrhage. The most frequent exciting causes are intemperance, exposure to cold and wet, and sexual excess. Highly acid urine in gouty patients is said to act as an exciting cause *per se* in some cases, but it is in the highest degree doubtful if such a condition of the urine could bring about obstructive spasm in a perfectly healthy canal. It is, however, an important element in spasm produced by excesses of various kinds and cold-taking. Instrumentation of a sensitive canal, especially if organic disease exists, is likely to develop spasmodic stricture which may last for some days or weeks.

It was shown some years ago by Dr. Fessenden Otis that spasmodic stricture frequently becomes chronic. This condition of chronic spasm he termed urethrismus. It is usually due, according to Otis, to sources of reflex irritation in the urethra, or in the vicinity of the scrotum and testicles. It may, however, be due to highly acid urine and is an occasional concomitant of the gouty diathesis.

Diagnosis.

The diagnosis of spasmodic stricture is usually comparatively simple, particularly in those cases in which retention comes on sud-

denly. It is obvious that the sudden occurrence of retention in a case of organic stricture, or other obstructive lesion of the genito-urinary tract, in which the stream of urine has been previously only moderately lessened in size, must depend upon some complicating condition—either inflammation and congestion at the site of the organic lesion, spasmodic contraction of the cut-off muscle, or both conditions in combination. A certain degree of inflammation or congestion is to be inferred in every case of spasmodic retention of urine and requires due consideration; the predominating element of spasm is, however, the principal feature.

As a rule, in cases of sudden retention of this kind there is a history of some one or more of the exciting causes which have been enumerated.

In determining the dependence of retention of urine upon spasm, it is necessary to remember that in by far the majority of cases there is some organic foundation for the condition. When, in the course of treatment for organic stricture of small calibre, retention suddenly occurs, the predominating condition is usually congestion or inflammation. The occurrence of acute urethritis during the course of marked organic stricture is apt to superinduce sudden retention. The condition in these cases—although a spasmodic element exists—is mainly congestion and inflammation at the site of the stricture, which produces sufficient swelling to completely close it for the time being. Urethritis produced by the introduction of instruments brings about retention in the same way. Cases of stricture of large calibre, in which there is little or no obstruction to the passage of urine, may suddenly develop retention from spasm. It is doubtful whether congestion or inflammation alone could produce closure of the canal in such cases.

It is sometimes difficult to determine, during instrumentation of the canal, how much of the obstruction to the passage of instruments is due to organic contraction, and how much to spasm. For example, after an instrument has passed a stricture of large calibre in the penile portion of the urethra, or an inflamed and irritable meatus, it will be found to be obstructed in many cases as it enters the membranous region. A steel instrument is less likely to be obstructed than a soft bulbous one, and the spasm is more likely to yield to steady and gentle pressure against it with the point of the sound than to a soft bulb. If there be organic contraction in slight degree at the bulbo-membranous junction, a steel instrument small enough to pass the stricture in the anterior portion of the canal will, in all probability, slip by and fail to detect it. A large bulbous instrument will usually fail to pass altogether, but if a small bulbous bougie be

introduced, it will be found that the spasm of the surrounding muscles, although insufficient to obstruct the passage of the instrument into the bladder, will at the same time contract the stricture in such a manner that the shoulder of the instrument impinges upon it as it is withdrawn. The peculiar feel imparted to the bougie, and the sudden snap produced by the passage of its shoulder through the organic contraction, will determine the exact nature of the case.

There are some exceptional cases of chronic spasmodic stricture in which the real condition can be demonstrated only by the subtraction of all sources of direct or reflex irritation, after which the supposed organic stricture will disappear.

Treatment.

Obviously, the first indication in the treatment of spasmodic stricture is to remove all predisposing causes as far as possible. Such conditions as the gouty and rheumatic diatheses require correction. General nervous irritability and hyperæsthesia may require nervine tonics, or sedatives and anti-spasmodics, or both, according to the special indications present. The principles of genito-urinary and sexual hygiene should be thoroughly impressed upon the mind of the patient. Once succeed in disabusing the patient's mind of the fallacious notion that his penis and testes constitute the axis around which his earthly existence revolves, and the treatment of the case is much simplified. Every possible source of local and reflex irritation must be removed. This necessarily involves in the majority of cases the cure of organic lesions of the urethra. The urine should be kept bland and non-irritating by dietetic measures and the administration of alkaline remedies. Careful study should be given in each case to the degree of tolerance of the urethra for instrumental manipulations. The amount of irritability of the urethra and the degree of spasm excited by the passage of instruments is a fair criterion of the frequency with which they should be introduced in the treatment of organic stricture.

When retention comes on as a consequence of spasmodic stricture, an attempt should be made to relieve the condition by derivation —with a view of removing possible congestion—and by antispasmodics. The passage of instruments should be avoided if possible, as tending to increase irritation and spasm. The full hot bath, and morphine by the mouth or hypodermically, should be depended upon as far as practicable. Very often the patient will succeed in passing urine while in the hot bath, which is both derivative and antispasmodic. When these simpler measures fail, a small soft cathe-

ter should be carefully introduced, while the patient is in the bath if possible. If necessary, chloroform or ether may be given to the extent of full anæsthesia, for the purpose of relaxing the spasm. Whenever retention comes on in the course of organic stricture, it must be remembered that the accident is not due to the organic contraction *per se*, but to certain plus conditions, *i.e.*, spasm, congestion, and œdema of tissue in varying proportions. The relief of the retention depends upon the subtraction of these plus conditions from the primary obstructing factor of organic contraction. The treatment of urethrismus is chiefly operative. After all sources of reflex irritation have been removed the urethrismus disappears.

Congestive or Inflammatory Stricture.

This is usually a complicating condition rather than a pathological entity, being much less frequently met with as a prime factor in the case than spasm. Even the rare existence of congestive and inflammatory stricture as an essential condition is denied by many surgeons, but it would at least appear to be the main feature of a minor proportion of cases of urinary obstruction, with or without retention. This congestive or inflammatory obstruction may occur—(1) as the result of occlusion of the urethra by extensive infiltration of the mucous membrane, peri-urethral connective tissue, and corpus spongiosum, in severe or virulent urethritis; (2) at the site of an injury to the mucous membrane produced by instrumental or accidental trauma from within or without the canal; (3) as a consequence of acute and virulent urethritis affecting strictures of large calibre or congested and granular patches of the mucous membrane.

The indications for treatment are the same as in spasmodic stricture—which is usually a complicating factor—with the exception that in cases in which hyperæmia is believed to be the predominating condition the application of leeches to the perineum is advisable.

Organic Stricture.

Organic, permanent, or fibrous stricture is that form in which the narrowing of the urethral calibre is due to an aggregation of organic tissue formation, and may be either congenital or acquired. It is most often acquired, and is most frequently met with, between the ages of twenty-four and forty-five.

Very rarely indeed does a stricture give trouble for the first time after the age of forty. It may occur at any time after the period of puberty.

Traumatic Stricture.

Traumatic organic stricture may occur at any age. The youngest case which has come under the author's observation was in a boy of thirteen.

Traumatic stricture is usually located at the triangular ligament. It is at this point that the urethra is likely to be injured by blows or falls. A fall astride a hard object or a kick in the perineum is the usual cause. The bulbo-membranous urethra is caught between the impinging body and the sharp, knife-like lower border of the subpubic ligament, and a very slight degree of force may therefore produce permanent injury. It does not require a very great degree of violence to completely sever the urethra in this situation. The pendulous urethra, on the other hand, is rarely involved in traumatic stricture on account of the difficulty with which it can be caught between two impinging bodies.

Traumatic stricture is distinctly cicatricial. It is rarely amenable to dilatation, and usually requires a perineal section.

Congenital Stricture.

The congenital form of stricture is rare, if we exclude narrowing of the meatus. The existence of congenital stricture beyond a point one-fourth of an inch from the meatus is denied by the majority of surgical authorities. If, however, we take into consideration the occasional occurrence of congenital atresia of a part or the whole of the urethra, the possible occurrence of localized congenital narrowing of the canal seems logical. I have seen a number of cases of linear stricture of the pendulous portion of the canal which I believe to have been of congenital origin.

Congenital stricture of the meatus is a relative affair, inasmuch as it is not *per se* productive of discomfort, in by far the majority of cases. An individual with a meatus narrower than the average is not likely to be annoyed thereby, providing he never contracts gonorrhœa.

In order to determine the condition of the urethra, or to treat organic disease of the mucous membrane, the meatus must admit instruments of a size corresponding to the largest mean diameter of the canal.

Whenever, therefore, there exists a suspicion of urethral, prostatic, or bladder disease and the meatus is contracted, it should be enlarged by incision to a size sufficient to admit an instrument which will thoroughly distend the canal.

In by no means exceptional instances a contracted meatus of congenital origin has been known to induce reflex neurotic disturbances in very much the same manner as does a phimosed prepuce in some cases. Spasmodic stricture, irritability of the bladder with frequent micturition, and perhaps other more suspicious symptoms of stone have been known to arise from this cause.

Organic Stricture of Inflammatory Origin.

According to conformation, organic acquired stricture occurs in three principal varieties. (1) The first and simplest form is known as the linear stricture, the obstruction corresponding to that which would be produced by tying a narrow cord about the canal.

(2) The second variety is wider, and is known as the annular form, the condition being mechanically similar to that which would result from tying a flat band or piece of tape about the canal.

(3) The third form—which is divided by some authorities into several peculiar sub-varieties—involves a considerable extent of the urethra in an irregular contraction, and is known as tortuous stricture. For practical purposes these three varieties are sufficiently distinctive.

As regards their clinical features, strictures may be described as (*a*) simple and readily dilatable; (*b*) irritable, involving local hyperæsthesia and hyperæmia; (*c*) resilient or elastic; (*d*) recurrent. This classification necessarily depends largely upon the behavior of the stricture under treatment.

The number of strictures is variable. It has most generally been accepted that stricture is usually single, but it will be found in by far the larger number of cases, if the urethra be carefully explored, that more than one stricture exists.

The amount of contraction in cases of stricture varies greatly, between those of large calibre, in which there is but superficial thickening with loss of elasticity of the mucous membrane, and those severe forms of long-standing stricture in which the lumen of the urethra is so contracted as to resist the introduction of a fine bristle, even when the stricture is exposed post-mortem. The contraction is seldom sufficient to completely prevent the passage of urine.

The explanation of the rarity of strictures impermeable to urine is a very simple one. Every intelligent practitioner knows how difficult it is to heal a fistula in the tissues which communicates with secreting strictures or with a cavity containing materials which escape and enter the lesion. Urinary fistula, fistula in ano, and salivary fistula are familiar illustrations. The patency of urethral stric-

ture is not only facilitated by the passage of the urine, but also by the fact that the mucous membrane is usually intact, or at least in part.

Strictures impermeable even to instruments are also very rare, particularly in the practice of surgeons who exhibit sufficient patience, gentleness, and skill in instrumentation.

The location of stricture has been the subject of much controversy. Dr. Otis' investigations in particular have modified in certain quarters the existing ideas of the relative frequency of stricture at different points in the urethra.

Until recently the dicta of Sir Henry Thompson and others of his school as to the location of stricture have been universally accepted. Thompson found in 320 cases of stricture, examined clinically, 212 which were located at the bulbo-membranous junction, 51 in the spongy portion of the canal, at variable points between one inch anterior to the opening of the triangular ligament, and two and one-half inches posterior to the meatus, and 54 at the meatus or within two and one-half inches posterior to it. In 270 cases examined post mortem, he found a decided preponderance of stricture in the bulbo-membranous region, which he described as the space included between a point one inch anterior to the triangular ligament, and another three-fourths of an inch posterior to it. H. Smith examined 98 preparations of stricture in the London museums, and found only 21 in the membranous urethra, the other 77 being anterior to it. The majority of the latter were situated in the bulbous urethra or just in front of it. Otis claims that the condition is most frequently found in the penile portion of the canal. It is obviously impossible for the Thompson and Otis schools to arrive at harmonious conclusions as long as their standards of stricture and methods of exploration remain so widely different. Post-mortem evidence is only relatively valuable. The surgeon who reasons from clinical experience and skilfully uses the urethrometer and bulbs, can never agree with Thompson, and must acknowledge the accuracy of Otis' methods even though he may consider the conclusions of the latter somewhat overdrawn. It has been my experience that the most frequent site of stricture appears clinically to be at the meatus or just within it, most of these cases, however, being congenital. The next most frequent point is the junction of the bulb and fossa navicularis, or just posterior to it, *i.e.*, two and one-half to three inches from the meatus. The next most frequent location is the bulbo-membranous junction, and the next about one inch anterior to it. It seems to occur with varying frequency in the intermediary portions of the canal.

From a clinical standpoint, the author has come to regard stric-

ture as any condition of the urethra which is capable of producing friction, by obstructing the flow of urine, to however slight an extent, providing said obstruction and friction are productive of pathological disturbances, or—if the latter have already begun—tend to perpetuate them. A point of normal contraction, or relative inelasticity, becomes a stricture only when the urethra assumes a pathological state; the previously normal lack of distensibility is then of great pathological and surgical importance, and its removal may be imperatively necessary.

Believing then that any point of contraction or inelasticity in the urethra, in the presence of a pathological condition of the mucous membrane, constitutes a stricture, the author unhesitatingly reiterates his firm conviction that stricture of the urethra is most frequent in the pendulous portion of the canal. If care be taken to exclude the element of deep urethrismus—which exclusion is not so easy as some authors would have us believe—the proportion is, the writer believes, at least 10 to 1.

The prostatic portion of the urethra is never involved in acquired stricture as far as known. This immunity is due to (1) the rarity of extension of the acute inflammation to its mucous membrane, and (2) the distance of the part from the primary point of infection.

Morbid Anatomy.

As might be inferred from its origin, the characteristic changes at the site of a stricture are essentially those of chronic inflammation. Urethritis having become localized at some point or points in the canal, the inflammation extends to the submucous tissue, or if peri-urethral thickening already exists, it is increased; the process consisting of a submucous infiltration of embryonal cells, which eventually form a zone of peri-urethral sclerosis of variable density. There may or may not be a variable degree of infiltration and thickening of the corpus spongiosum. The result of the adventitious deposit is an encroachment upon the lumen of the canal and a loss of elasticity commensurate with the degree of the pathological process. In some instances there is a slight thickening of the mucous membrane with little or no submucous infiltration, the mucous epithelium being lost to a greater or less extent, and the part covered with muco-purulent secretion. The follicles of the urethra at this point are dilated and thickened and show evidences of hypersecretion. At a more advanced stage the mucous membrane becomes extremely thickened, congested, and perhaps covered with fungoid granulations. In old and pronounced cases the corpus spongiosum is extensively

infiltrated and of a semi-cartilaginous consistency. The condition, in brief, is one of chronic interstitial inflammation. Bridles, bands, or flaps of thickened mucous membrane may be present. The degree of occlusion of the canal is variable. In some cases the process is localized, perhaps only partially involving the circumference of the canal, its lumen being very slightly contracted. In the more marked forms the occlusion may be almost complete.

The secondary results of stricture are due to three conditions: 1. Mechanical obstruction to the outflow of urine; 2. Germ infection; 3. Extension of chronic inflammation. The urethra anterior to the stricture may be somewhat contracted, this being due to its partial loss of function. Posterior to the stricture the urethra is more or less dilated and contains a greater or less quantity of residual urine in combination with the products of infectious inflammation and decomposition. This secretion alone or combined with epithelium rolled up by the outflowing urine appears at the meatus in the form of a characteristic gleety discharge or as the so-called *Tripperfaden—i.e.*, shreddy filaments which float about in the urine. The secretion may be mixed with more or less blood if the mucous membrane be extremely congested. Crystallization of urinary salts with resulting urethral calculus may occur behind the stricture. As the case advances, the mucous membrane behind the obstruction becomes thinned and perhaps ulcerated. It may give way during a straining effort at micturition. The infectious urine under such circumstances escapes into the peri-urethral cellular tissue and produces abscess with resulting fistula, or possibly infiltration of urine with acute septic cellulitis and death. All of the glandular tissues tributary to the urethra are involved in the chronic inflammation. The urethral follicles, prostate glands, Cowper's ducts, and the ejaculatory ducts become dilated and thickened. The bladder is always involved to a greater or less degree. It is mechanically disturbed as a result of the backward pressure of the urine during micturition. It is also likely to become affected by chronic inflammation either by extension or by the upward migration of germs. The bladder may become sacculated, undergoing precisely the same changes as in long-standing cases of prostatic hypertrophy. Thickening of the bladder walls, severe chronic cystitis, vesical calculus, and involvement of the ureters and pelvis of the kidney are possible results. Pyelitis with or without the formation of renal calculi will be found to exist in certain extreme cases. Pyonephrotic or perinephritic abscesses may occur. In a general way the secreting structure of the kidney may be said to undergo those changes which are described under the omnibus term "surgical kidney," involving chiefly an interstitial prolif-

eration of connective tissue and a deficiency of the elements of the normal stroma. The kidney is always more or less hyperæmic. Its cortical structure may be dilated and thinned. The condition of the kidney is such that a complete inhibition of its function may follow a slight increase of hyperæmia. Reflex shock upon such a damaged kidney incidental to operations upon the genito-urinary tract, or direct irritation from anæsthetics, and particularly ether, are liable to precipitate uræmic coma or convulsions and death.

The density of the stricture varies with its origin, duration, and the amount of irritation present. Traumatic and chemical strictures are typically cicatricial.

Symptoms.

One of the earliest symptoms is disturbance of the function of urination. This consists in frequency of micturition due to two causes, viz., (1) reflex irritation of the prostatic urethra or of the vesical neck, and (2) direct irritation from germs and their products developing behind the obstruction. Some patients first consult the surgeon regarding increased frequency of micturition occurring only at night, having been troubled in this way perhaps for many years without the development of any other symptoms. Strictures at or near the meatus are especially liable to produce reflex irritation of the vesical neck. Dribbling of urine after micturition is an early symptom. This is due to interference with the continuous wave of contraction of the accelerator urinæ muscle, the function of which is to expel the last few drops of urine. Imperfect ejaculation of semen results from a similar condition. The stream of urine may be forked or twisted according to the form of the stricture. There may be several streams simultaneously expelled from the meatus and taking unusual and inconvenient directions. The stream may present a fan-shape or resemble very much a stream of water thrown from a garden sprinkler. As the case progresses the patient notices that it is necessary to bring into play the auxiliary action of the abdominal muscles in micturition. The stream of water finally becomes very small and complete retention may at any time occur, especially if the patient be exposed to causes of spasm or congestion of the affected part. Neurotic symptoms are sometimes present. Neuralgic pains in various situations, especially in the vicinity of the genito-urinary organs, are quite frequent. Pain in the back, genito-crural neuralgia, pain in the testes and perineum, and sometimes pain reflected to the anus and rectum are observed. Profound mental depression and pseudo-impotence are occasionally met with. General malnutrition, hypochondria, and malaise are often noted. A certain degree of

general toxæmia is sometimes responsible for the various general symptoms present in stricture. This may be of a distinctly uræmic type, or due to the absorption of toxines from the site of the lesion or such portions of the genito-urinary tract as may happen to be the site of bacterial action. One of the most characteristic symptoms of stricture is a gleety discharge. While this discharge is by no means pathognomonic of stricture, it is safe to assert that it is indicative of that condition in by far the larger number of cases. Gleet should always be regarded as symptomatic and its causes sought for. In stricture, the gleet may be the perpetuation of a more or less recent gonorrhœa, or it may be of recent development and due to the gradual encroachment of the adventitious tissue upon the urethral lumen with resulting decomposition of residual urine and the development of chronic inflammation. Hemorrhage during the sexual act or during micturition is an occasional symptom.

Diagnosis.

The diagnosis of organic stricture can only be made by instrumental exploration of the canal. An essential requisite is a moderately capacious meatus. It is impossible to explore a canal of say a calibre of 40 French through a meatus with a calibre of 20. Otis' urethrometer was devised to overcome this objection, but it is by no means as satisfactory as the exploring bulbs. The best instrument for exploration is the rubber *bougie exploratrice* of Guyon. This has a flexible shaft and a comparatively hard bulbous extremity with an abrupt shoulder. Next in value come the exploring bulbs of Otis. With a good-sized meatus, these bulbous instruments enable us to detect points of contraction and tenderness in the urethra which will be overlooked entirely if the ordinary sound be used. There should be no hesitancy in incising the meatus if necessary for exploratory purposes. Indeed, meatotomy should be considered necessary as a preliminary in both the diagnosis and treatment of urethral disease in any case in which the meatus will not admit at least a 30 French.

With regard to the measurement of the urethra for diagnostic purposes, Dr. Otis' method of determining the calibre of the urethra by the circumferential measurement of the penis is fallacious. The conditions governing the amount of blood in the organ and consequently its size are so variable that the method is necessarily inaccurate. When it is necessary to incise the meatus the operation should be performed with a blunt-pointed, straight-backed bistoury.

There are several points aside from the existence of obstruction which may be determined by urethral exploration. These are: (1)

The degree of contraction; (2) Its distance from the meatus; (3) By the withdrawal of the bougie its shoulder may be made to impinge upon the posterior surface of the stricture, thus enabling us to determine the breadth of the obstruction; (4) The number of strictures. This is somewhat difficult at times, because one or more of the strictures may be so small as to prevent the introduction of an instrument large enough to impinge upon deeper obstructions. This objection does not apply to the urethrometer; (5) The condition of the urethra behind the stricture may be determined by examining the secretion withdrawn upon the shoulder of the instrument; (6) The amount of congestion present may sometimes be estimated; (7) Resiliency or irritability of the stricture.

Prognosis.

This involves two conditions: First, its curability, and second, its danger to life. The possibility of a radical cure is disputed by the majority of surgeons, the general opinion being that a stricture once formed is never cured. It is, nevertheless, the writer's opinion that a properly performed urethrotomy is usually curative of strictures in the anterior portion of the canal. Deeper strictures are more difficult to cure, but even here thorough operation may be followed by permanent relief. When a stricture does not recontract to a greater or less degree within six months or a year after the cessation of treatment, the prospect of a permanent cure is always fairly good. Recurrence after urethrotomy takes place much more readily in cachectic, strumous, gouty, rheumatic, and syphilitic patients than in those who are healthy. Even when dilatation has been successfully practised, the patient may remain practically free from a recurrence of his stricture, provided a sound be passed at regular intervals.

The prognosis of stricture as regards its danger to life varies according to the duration of the disease, the severity of its complications and sequelæ, and the method of treatment. The most important factor is the condition of the kidneys. Impairment of structure and function of these organs is to be inferred in all cases of organic stricture of long standing. Such pathological aberrations of the kidney are not only immediately dangerous to life, but render all surgical measures of treatment more or less dangerous. Renal changes are usually responsible for the fatal result which ultimately occurs in neglected cases of severe stricture.

Localization.

The predilection of stricture for different portions of the canal has not been clearly explained by the various authorities upon the

subject. The explanation usually given for the relatively greater frequency of occurrence of stricture in various portions of the canal—more particularly in the bulbo-membranous region—is the presence of a greater amount of erectile tissue, and a more marked tendency to localization of inflammatory processes here than in other portions of the canal.

There are several points to be considered in the explanation of the occurrence of stricture in any particular location, and in some instances there are certain special elements in its production which are worthy of attention.

Acquired stricture at or just within the meatus is favored by the existence of congenital narrowing at this point. There is constant obstruction to the passage of urine, and the friction thereby induced inevitably enhances inflammation. There is, moreover, a tendency to the accumulation of secretions behind it.

The introduction of the nozzle of the ordinary syringe in injecting the urethra necessarily produces considerable irritation when the meatus is very narrow. These considerations explain the frequency with which acquired stricture is found just within the meatus.

The relative dilatation of the bulbous portion of the spongy urethra and of the fossa navicularis undoubtedly favors the retention of a small quantity of urine and of pathological discharges at these points, but this element in the causation of stricture is not very important until actual obstruction by inflammatory thickening of the mucous membrane occurs just in front of the dilated point.

When stricture begins to form there will inevitably be a small quantity of urine left in the canal after micturition. The author believes, however, that this condition assumes little importance until the stricture becomes very thick, as the residual urine is not allowed to remain undisturbed for any great length of time.

Strictures produced by injury to the canal during the passage of instruments necessarily occur at the site of the lesion thereby produced.

Traumatic strictures produced by falls and blows upon the urethra correspond to the seat of the injury. In the deep and fixed urethra such strictures occur most frequently at the bulbo-membranous junction, for reasons already stated.

The location of strictures due to the introduction of strong chemical and caustic substances into the urethra is at the site of their action. Foreign bodies in the urethra may produce localized inflammation—and perhaps ulceration—which determines the site of a subsequent stricture.

Injury incidental to chordee is often responsible for the localiza-

tion of stricture. This condition interferes with the normal distensibility and elasticity of the urethra, and during erection produces a strain and perhaps rupture of the corpus spongiosum and urethra at some particular point. This may be produced by the patient forcibly bending the penis. The writer believes that it may result also from frequent and vigorous erections.

By far the most important element in the determination of stricture is the existence of certain normal anatomical peculiarities of the canal. This is the chief bone of contention among the warring factions whose *casus belli* is the question, to cut or not to cut.

It has been shown by Weir, Sands, and others that there are certain points of narrowing in the spongy portion of the canal which have been termed by them normal contractions, these being distinct from the normal points of contraction usually recognized, namely, the meatus, the bulbo-membranous junction, and the point of union of the spongy urethra with the fossa navicularis. This description is somewhat misleading. The urethra is an elastic tube susceptible of considerable dilatation. Its elasticity, however, is not uniform throughout, but as a consequence of sparsity of elastic tissue, with a preponderance of connective and fibrous tissue in the erectile structure of the corpus spongiosum and a deficiency of areolar tissue beneath the mucous membrane, there exists at various points in the canal relative inelasticity and limited dilatability of the urethra.

It is well known that in certain portions of the canal relative inelasticity and limited dilatability are due to certain anatomical peculiarities of the surrounding structures, *e.g.*, at the opening in the triangular ligament, the junction of the fossa navicularis with the spongy urethra, the junction of the latter with the bulb, and at the meatus. At these various points the areolar tissue beneath the mucous membrane is scanty and the latter is more closely applied to the tissues upon which it rests. There is normally more strain at these points of narrowing than at any other portion of the canal, hence the urethra is here reinforced by an increased density of fibro-connective tissue.

In explaining the localization of stricture, we will take as our point of departure the fact that the urethra is a dilatable tube, the elasticity of which varies at different points in the canal. Through this tube water at a certain pressure, and in a certain volume, is forced at more or less frequent intervals. Obviously the greatest friction is produced at the various points of normal contraction and relative inelasticity. Against the strain and friction produced at these points nature has provided a certain amount of reinforcement of tissue, and under normal circumstances, with a healthy mucous

membrane, this pressure and friction do not produce injury. When, however, the canal is inflamed, its lumen and elasticity are decreased. Urine is nevertheless pumped through the tube in as great a volume and with as great frequency as under normal circumstances, producing by its mechanical pressure, friction, and chemical effects considerable irritation, as is evidenced by the consequent pain and smarting. Obviously, the greatest amount of irritation occurs at the points of relative inelasticity of the canal, and as a consequence it is here that inflammation tends to localize itself and persists,—perhaps long after the remainder of the mucous membrane has returned to a condition to a greater or less degree approximating the normal. This chronic inflammation results in a deposit of reparative material, which organizes and encroaches upon the lumen of the canal, forming, in short, organic stricture.

Regarding the relation of normal points of contraction to stricture, it may be said that such points of relative inelasticity and points of acquired contraction may be precisely the same from a clinical standpoint in the presence of a pathological condition of the mucous membrane. There is no difference in results, and there should be none in treatment, between a gleet perpetuated by normal points of friction and a similar discharge perpetuated by acquired contraction; the cure of the case demands their removal independently of their origin.

Treatment.

General Management.—The successful treatment of stricture of the urethra is dependent not only upon the proper selection of surgical methods of management and skill in their application, but upon the manner in which the general management of the case is conducted. Careful attention on the one hand, or neglect on the other, may determine the success or non-success of surgical treatment. Thus dilatation may fail of its object because of irritability or resiliency of a stricture, which attention to certain details in the general management of the case might avoid. Urethrotomy, divulsion, or perineal section may result fatally because of failure on the part of the surgeon to study carefully the condition of other portions of the genito-urinary tract and to appreciate the general and local conditions prevailing at the time of the operation.

In no disease of the genito-urinary tract is attention to genito-urinary and sexual hygiene more essential than in the management of stricture of the urethra. Regulation of the diet, temperate habits, sexual moderation or abstinence, and avoidance of exposure to cold and wet, are all important. The use of tobacco should be interdicted as

tending to induce general irritability and hyperæsthesia. The writer believes, moreover, that it is especially irritating to the genito-urinary tract. Chilling of the feet and legs is apt to be especially injurious, its effect in producing acute hyperæmia and inflammation being precisely similar to its results in enlargement of the prostate, in which disease the disastrous effects of exposure are so well known. The administration of alkalies for the purpose of neutralizing the urine is essential in the majority of cases. When pronounced cystitis exists, certain remedies will be found beneficial by preventing decomposition of the urine and consequently lessening its irritating properties. Boracic acid in ten- or fifteen-grain doses several times daily. naphthalin, creosote in small doses, oil of eucalyptus, benzoate and salicylate of soda, and in some instances small doses of turpentine, are useful for this purpose. In the author's experience the oil of eucalyptus in ten-minim doses has been of especial value; indeed, it is the urinary antiseptic *par excellence*. The activity of the skin should be promoted by Turkish baths and rubbings. The effects of sudden atmospheric changes should be avoided by wearing warm flannel garments of uniform weight. Exercise should be taken in moderation; fatigue and over-exertion should be avoided; perfect rest may possibly be indicated.

Certain local measures are very essential in the management of stricture. A tendency to spasm and congestion at the site of the stricture may be prevented by the daily use of hot sitz-baths or the occasional application of leeches to the perineum. As a matter of routine, the writer advises his patients to take a hot sitz-bath nightly before going to bed. By proceeding in this manner, it will be found that the majority of cases of stricture will be much more tractable than under ordinary circumstances. In some cases of very tough, resilient stricture, the canal may be dilated much more readily if the patient be directed to take an injection of water as hot as can be borne night and morning. These injections should be kept up for half an hour at a time, and may advantageously be made antiseptic by the addition of bichloride of mercury, 1 in 20,000, or boric acid in saturation.

Where manipulations of the canal tend to excite urethritis, hot bichloride irrigations, as recommended for chronic urethritis, may be cautiously employed. The various balsamic preparations are of service in such instances.

Pain and spasm may be excited by each attempt at dilatation, in spite of the general measures already recommended. Under such circumstances, a small dose of morphine may be given hypodermically, by suppository, or by the mouth, a short time before the oper-

ation. When each operation tends to produce urethral chill or fever, the administration of opium has a decidedly conservative and prophylactic effect. It will be found that in these cases of irritable stricture with a predisposition to urethral fever, thorough irrigation of the canal with a hot bichloride solution before and after the introduction of a sound or before cutting operations, as the case may be, will generally obviate the difficulty. The author would particularly call attention to the advantages of this procedure, as it will certainly tend to prevent the septic element in the production of urethral fever. Quinine, jaborandi, eucalyptus, and diuretin are probably all serviceable as prophylactics against chill, but eucalyptus is the most valuable.

Selection of Method.—The various forms of treatment which have been recommended for stricture are the following:

1. Caustics.
2. Continuous dilatation.
3. Gradual dilatation.
4. Dilating urethrotomy, or a combination of section and rupture.
5. Divulsion or rupture.
6. Internal urethrotomy.
7. External perineal section or urethrotomy with a guide.
8. External perineal section without a guide.
9. Electrolysis.
10. Subcutaneous section.
11. Excision, with or without a plastic operation.

The treatment of stricture by caustics is a relic of surgical barbarism, and is hardly worthy of serious attention. The objects for which it was originally recommended were (1) the destruction of the stricture, and (2) diminution of the sensibility of the mucous membrane for the purpose of allaying irritability and spasm of the canal. The substance used was generally caustic potash. Whatever the results may have been, as far as restoring temporarily the calibre of the canal was concerned, the inevitable consequence of such atrocious surgery must necessarily have been the substitution of a chemical stricture for an ordinary organic one. As is well known, stricture due to actual destruction of tissue is the most severe form with which we are called upon to deal. All the other methods of treatment which have been enumerated have their advocates at the present day—either as a matter of routine or a range of treatment from which to make a selection—and may under proper circumstances be practised with advantage in different cases. The selection of the method is necessarily—within certain limits—a matter of choice on the part of the individual surgeon. The various legitimate methods will

receive special consideration after their applicability to the various forms of stricture has been outlined.

Of the various methods enumerated, there are but two which in the opinion of the author require serious consideration, these being dilatation, continuous or systematic, and urethrotomy, internal and external.

For practical purposes the surgical treatment of urethral stricture may be divided into that of—

As regards location.
1. Stricture of the meatus.
2. Stricture of the penile urethra.
3. Stricture of the deep urethra.

As regards character.
a. Simple uncomplicated stricture.
b. Irritable stricture.
c. Resilient and elastic stricture.
d. Recurrent stricture.
e. Dense and hard tortuous stricture.
f. Complicated stricture.
g. Traumatic stricture.

To a certain extent the treatment of each particular case is modified by the calibre of the contraction; for example, in tight strictures which it seems advisable to treat by sounds, metallic instruments should not be used until a moderate amount of dilatation has been attained. The treatment is further modified by the occurrence of complications, such as false passages, retention of urine, severe cystitis and pericystitis, infiltration of urine and abscess, fistulæ, enlarged prostate, etc.

Stricture of the Meatus.—This demands division by the knife irrespective of the cause of the stricture. In the presence of a pathological condition of the urethra, any meatus which prevents the introduction of an instrument of sufficient size to distend the remainder of the canal to its extremest capacity, should be considered as strictured. The incision should always be made in a downward direction, and if care be taken to divide all strictured bands behind the external orifice with the belly of the knife, a sufficiently large meatus can always be obtained without the production of deformity. The after-treatment of meatotomy consists in dilatation every second day until healing has taken place.

Stricture of the Penile Urethra.—Strictures in the penile portion of the urethra when recent and soft may yield to dilatation. Strictures of large calibre, the foundation of which is a normal, or at least a congenital, point of relative inelasticity of the canal, are not likely to yield to dilatation. The author believes that his experience justifies him in asserting that in by far the larger proportion of cases of penile strictures the gleety discharge characteristic of such conditions usually continues—perhaps with acute exacerbations—until the urethra has been put completely at rest and the source of irritation re-

moved by urethrotomy. If the penile stricture be very tight, preliminary dilatation is usually preferable to an extensive primary urethrotomy. Strictures of the penile portion of the canal are quite likely to be multiple. When such strictures are irritable, as they are likely to be, very slight causes are sufficient to produce a urethritis, the severity of which depends upon the degree of irritation. The presence of reflex symptoms referable to the prostate, bladder, or kidney invariably demands urethrotomy.

Operation.—Extensive experience has demonstrated to the author that the method of dilating urethrotomy, as perfected by Otis and performed with the instrument which he has devised, is upon the average the simplest, safest, and most successful method of treatment of penile strictures. The author has devised a series of bulbs with a cutting blade, which are often preferable to the dilating urethrotome in slight linear strictures; but the stand-by of the surgeon is the instrument of Otis. In the performance of the operation the strictest asepsis should be maintained. The surgeon should be as careful of his instruments and hands as though he were about to enter the abdominal cavity. The urethra should be flushed with a 1–10,000 to 1–20,000 solution of bichloride of mercury as a preliminary step in the operation. The operation may be done under cocaine in most instances. The author uses a solution of two per cent. cocaine and one per cent. carbolic acid. This appears to be safe and is quite as efficient as stronger solutions. It is not best to lay down any arbitrary rules for the performance of the operation. The size to which the urethra should be enlarged is to be determined by the personal equation. The largest-sized instrument which the meatus will admit, when incised to the fullest capacity possible without the production of serious deformity, is in a general way a safe criterion of the size of the instrument which the rest of the urethra will admit. It is the custom with some surgeons to use the retained catheter after internal urethrotomy. This, however, is not necessary in the majority of instances. Systematic dilatation is necessary after the operation in order to prevent recontraction and to secure smooth healing of the wound. The instrument should not be passed, as a rule, before the third day, and when there is much inflammation it is perfectly safe to allow the urethra to remain undisturbed for from five to seven days. It should be dilated thereafter at intervals of three or four days, which interval is gradually increased. Dilatation should be persisted in for from four to six weeks or longer, according to the exigencies of the case. The author desires to lay special emphasis upon the fact that sounding is usually performed too soon and too frequently after urethrotomy.

In the author's monograph upon stricture of the urethra, the treatment of strictures of the penile urethra is summed up as follows:

1. Those located within two and one-half inches from the meatus cannot possibly be cured by dilatation, and must be cut.

2. Pronounced cases in any portion of the penile urethra must be cut either immediately or after preliminary dilatation, in by far the majority of cases.

3. The treatment of marked cases of small calibre may be begun by continuous or gradual dilatation with soft instruments up to the size of 15 or 16 French, or even larger, and in some cases it may be advisable to continue the dilatation with soft instruments beyond this point, until the stricture shows irritability.

4. Strictures of large calibre, strictures of recent formation, and those consisting of points of normal inelasticity which are perpetuating gleet, may be treated by dilatation, the patient being forewarned that the treatment may prove unsuccessful, and that urethrotomy will probably be required either within a short time, or later on, on account of a recurrence of urethritis dependent upon the contraction. In other words, the patient should be informed that the treatment by dilatation, although it may prove efficacious in temporarily relieving the gleet and other symptoms of stricture, may at the same time fail to produce a permanently satisfactory result, and that he will constantly be predisposed to attacks of inflammation from the slightest indiscretion. Should the patient be satisfied with treatment of this kind, it is hardly wise for the surgeon to insist upon an operation.

Respecting the prognosis after internal urethrotomy, the author desires to express his faith in the permanency of the result in the majority of cases, if the operation be properly performed.

Stricture of the Deep Urethra.—This condition implies those strictures which involve the bulbo-membranous region. They are generally the most serious form, the gravity of the stricture being directly proportionate to its distance from the meatus. In selecting the method of treatment for deep stricture, it should be remembered that no method has yet been generally accepted as affording a prospect of a permanent cure. Inasmuch, therefore, as radical operations do not promise a great deal, we should lean toward conservatism. It is to be understood, however, that many cases occur in which conservatism may be dangerous. The author holds that perineal section offers a better prospect of radical cure than is generally believed, and that it should be oftener performed.

Simple, soft, uncomplicated stricture of the deep urethra should be treated by dilatation. If the stricture be of small calibre, continuous dilatation with soft instruments may be practised at first.

As soon, however, as it is possible to introduce moderately large steel instruments they should be used. Continuous dilatation may be practised for from twenty-four to forty-eight hours in very tight strictures, and intermittent dilatation by soft instruments may be practised daily, or every second or third day thereafter. Systematic dilatation by steel instruments should not be practised as a rule oftener than once in every three or four days, an interval of from five to seven days being often advantageous. Traumatic stricture of the deep urethra generally demands perineal section.

Irritable Stricture.—In this form of the disease the patient is usually of a strongly nervous and highly irritable temperament, and the urethra extremely hyperæsthetic. Dilatation produces severe pain and spasm, and is often followed by chill and perhaps fever. Such strictures require urethrotomy. Resilient and elastic stricture is a condition in which the obstruction is apparently dilated quite readily, but the symptoms are not relieved, and on exploration with the bulb the coarctation is found to be still present. Urethrotomy is the *sine qua non* in this condition also. Recurrent stricture is really a variety of resilient stricture in which the property of resiliency is not immediately manifested, the symptoms, however, recurring very soon after apparently successful dilatation. The cutting operation is the only means of relief in this condition. The hard, so-called nodular strictures of cartilaginous consistency and long duration which are occasionally met with in the deep urethra, require, as a rule, perineal section. The same is true of hard and tortuous strictures with complications, and in cases in which economy of time is necessary, or in which the condition of the patient is such as urgently to demand relief. Traumatic stricture can rarely be relieved, save by urethrotomy. The author desires to place himself upon record as opposed to internal urethrotomy and divulsion of deep urethral strictures. Perineal section is much more surgical, quite aseptic by comparison, and places the field of operation under approximately perfect control. There are, to be sure, occasions when both divulsion and internal urethrotomy may be justifiable, but these instances are certainly rare.

Electrolysis has received considerable attention as a method of treatment for urethral stricture. It is the opinion of the author that this method of treatment has a very limited application. It is not to be condemned *in toto*, but the claims which are made for it by some of its enthusiastic advocates are certainly very much exaggerated. That it will in certain instances relieve what the author has termed plus conditions of stricture, viz., congestion, spasm, and œdema, is probable. When these conditions are removed, however, we are still confronted

with the presence of adventitious tissue constituting the true element of the stricture. Upon this the author firmly believes the electrolytic current has very little effect within the limits of safety.

Further discussion of the eminently surgical topic of the treatment of urethral stricture is hardly warrantable in a work intended primarily for the physician. The author will, therefore, sum up the treatment of the disease by presenting the following *résumé* which has appeared in his monograph upon urethral stricture:

1. Simple stricture, small calibre, or large calibre.	Continuous dilatation, followed by gradual dilatation. Gradual dilatation.
2. Resilient, elastic and recurrent stricture.	Internal dilating urethrotomy (exceptionally). Divulsion (exceptionally). Perineal section (usually).
3. Hard, tortuous, old, and complicated stricture.	External urethrotomy or perineal section.
4. Traumatic stricture.	Dilatation (very rarely). Internal urethrotomy (rarely). Divulsion (rarely). Perineal section (usually).
5. Stricture complicated by retention.	Relieve the retention and temporize if possible. Begin dilatation as early as practicable. Perineal section if operation is urgently necessary. Divulsion as the operation of necessity when no other means are at hand. Electrolysis, *i.e.*, galvanism as a temporary measure. This is to be followed by dilatation or urethrotomy as occasion requires.

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DISEASES OF THE URINE.

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DISEASES OF THE URINE.

In the following article upon certain morbid changes in the urine it has been deemed expedient in each case to revert to the old-fashioned custom of raising a symptom to the rank of a disease. It is true that common sense and experience combine in prohibiting us from giving undue prominence to any single symptom, but in dealing with urinary diseases the advantage to be gained by taking this course of action is undoubtedly great. Not infrequently the admixture of phosphates, urates, blood or pus with the urine constitutes the most salient, often the only evidence that changes in the functional or organic integrity of some part of the urinary tract are in progress. A clue line is thus at once presented to us, which, if it is properly utilized, will often lead to a correct determination of the locality and the character of the morbid condition demanding alteration or treatment.

HÆMATURIA.*

Blood derived from any part of the urinary system—whether from the secreting, conducting, or collecting divisions—and passed pure or mixed with the urine, constitutes the symptom known as hæmaturia.

This symptom, though occurring at one time or other in the course of all the more serious diseases affecting the urinary organs, has not received that attention at the hands of urologists which its importance demands. This neglect is perhaps accounted for by the fact that until quite recently the origin and cause of blood appearing in the urine could not be diagnosed with certainty.

Its prognosis was moreover uncertain and its treatment was empirical and haphazard.

Up to the date of the introduction of electric illumination of the bladder in 1888 by Max Nitze all our experience of the obscure diseases of the urinary tract was obtained slowly and with difficulty,

* For the sake of clearness a consideration of the conditions known as hæmoglobinuria and intermittent hæmatinuria (paroxysmal hæmoglobinuria) have not been included in this section, but are to be found elsewhere.

for it was acquired either by post-mortem examination or by operative interference.*

The cystoscope of to-day has, however, changed all this, for it enables the surgeon in a very large number of cases of hæmaturia not only to locate the source of the hemorrhage, but often to determine its cause, while it enables him at the same time to treat it rationally and successfully.

But the electric cystoscope is neither suitable nor available in general medical practice, for this instrument demands considerable tactile dexterity, much judgment, and some knowledge of electrical technique. Its employment, therefore, is not advocated in this article, and it has been attempted to incorporate the knowledge which has been acquired by its means in such a manner as to render endoscopy as superfluous as possible.

Causes of Hæmaturia.

Blood appears in the urine from a variety of causes, which are of constitutional or of local origin. The tabulated lists usually given in text-books embrace many causes which the practitioner will not meet with once in a life-time, and many which are mythical.† Although the following lists, which I have drawn up from accurate cystoscopic records, can be of comparatively little value in depicting the frequency of the various forms of hæmaturia which will be met with in routine work, yet they are probably as near the mark as can possibly be obtained.

If the bleeding of gonorrhœal prostatitis and ordinary nephritis be excluded, the first hundred cases of hæmaturia which I examined with the light in routine hospital treatment showed the following groupings:

Tumors of the bladder	31 cases.
Renal disease, including carcinoma, tubercle, stone, syphilis	24 "
Tubercular and other forms of ulceration of the bladder	22 "
Hemorrhagic cystitis	12 "
Encysted vesical stone	5 "
Prostatic hemorrhage	4 "
Uncertain	2 "
Total	100 "

* Sir Henry Thompson (Lectures 1884, p. 32), after advocating digital exploration of the bladder in obscure cases, says: "Indeed, it is difficult to say what may not be found, as fresh experiences have brought to light conditions to some extent not hitherto recognized. Hence there are few occasions, I confess, which for me have excited a more lively interest than the moment at which my finger enters a bladder, the condition of which has been a theme of keen inquiry and speculation for some months or even for years before."

† The days have gone when we may content ourselves with the diagnoses, given

Probably, however, as these were routine hospital patients they would not offer the same difficulty as those who were sent by practitioners for special examination. Taking fifty such cases in which doubt as to the cause existed, the following were the cystoscopic diagnoses:

Stone in the bladder	10	cases.
Tumors of the bladder	24	"
Stone in the kidney	6	"
Tubercle of the bladder	3	"
Tubercle of the prostate	2	"
Renal carcinoma	3	"
Cystitis	2	"
Enlarged prostate	1	"
Total	50	"

In order to treat hæmaturia with judgment and precision its source and cause must first be ascertained. In actual practice the mental problems of determining the locality and the cause are revolved almost simultaneously, and for the sake of conciseness and logical sequence they are considered together.

Diagnosis of the Source and Cause of Urinary Hemorrhage.

The objective signs and subjective symptoms furnished by each patient permit of certain guidance rules being framed for the determination of the source and cause of the bleeding. These, though by no means infallible, may be accepted as reliable. They are based upon (A) Examination of the urine; (B) Examination of the patient; (C) Critical examination of the symptoms complained of.

A.—Examination of the Urine.

(1). *The Color*—Some knowledge may be gleaned from the color of the urine.

Axiom: "The brighter and more arterial the color of the urine, the nearer the source of the bleeding is to the meatus urinarius."

Qualification: This is correct to a great extent, but it must be remembered that in severe injuries to the kidney, and in some cases of renal sarcoma and carcinoma, the blood is poured out so rapidly, and enters the bladder in such large quantities, that it is expelled therefrom almost as bright in color as when it issued from the rupture or from the vascular growth.

If, then, traumatism of the kidney and renal tumor before the age

and maintained by the older physicians without basis, of "nævus of the bladder," "the hæmaturia of mental emotion, of bodily exertion, of vicarious menstruation," and such like.

of five or over forty-five be excluded, bright arterial bleeding usually emanates from the lower urinary pasages.

Fallacy: There are some pitfalls which must be exposed. It is taught that smoky or beef-tea-looking urine is always renal in its source, because of the action of the acid urine upon the hæmoglobin of the blood. If this colored urine is accompanied by other signs of renal disease, such as casts, excess of albumin, and lowered specific gravity, the color indication is correct, but without these corroborative evidences it is a fallacy which must be studiously avoided, especially in the male subject.

A small amount of blood leaking into the bladder in any form of atony (such as that induced by stricture or prostatic enlargement) causes the urine to assume a beef-tea color, for the blood remains for some time in contact with the residual urine left in the viscus by inefficient expulsion.

Moreover, in certain cases, although there is no residual urine, the blood leaks from an abraded surface so slowly that it becomes mixed with a large amount of the healthy secretion. It is, therefore, voided merely "smoky."

Still more incorrect is it to insist upon a renal source because the blood is coffee-colored or black. The best example of "black bloody urine" is to be found in cases of profuse hemorrhage into the bladder accompanied by retention from clotting. It varies under these circumstances from the color of porter to a jet-black.

I could quote many cases illustrative of a wrong diagnosis of renal disease having been given, upon the ground that the urine was dark in color. One struck me especially:

A lady aged fifty-two, of sedentary habits, had been in the habit of passing coffee-colored urine at rare intervals during two and a half years. Her medical attendant had persistently treated her for kidney disease. One day she was suddenly forced to take a long railway journey, and in consequence probably of this unusual amount of exertion she began to pass very bright-colored blood and clots. Suspicions were at once aroused that the source of hemorrhage was the bladder, and I was asked to use the cystoscope. A large villous papilloma the size of a tangerine orange was discovered in a very capacious bladder. It was removed and the patient recovered.

This mistake is, I believe, the more readily made in early stages of the harder forms of carcinoma of the male bladder. The malaise or initial irritability of the bladder induces the practitioner to test the urine. Albumin to a slight amount is discovered in *clear* urine; this albumin is due either to serous leakage from the latent growth or to a microscopic escape of blood. The practitioner assumes it to

be from the kidney, and later on, when the vesical growth begins to bleed slightly into acid urine, and coffee-colored or beef-tea-like urine is passed, the diagnosis of a renal source is supposed to be confirmed, and it is only a month or two later, when a sharp rush of bright-colored blood appears, that the bladder is examined and the diagnosis is corrected.

(2) *The Shape of the Clot.*—Much information can be gathered from floating in water the clots which are passed by the patient.

Axiom: "Long, *dark* clots like earthworms* or quill-barrels indicate bleeding from the renal pelvis, for they are casts or moulds of the ureter."[1] All uncertainty is set at rest, however, if, after a transient cessation of the hemorrhage, long worm-like clots are passed partially decolorized, and if this is followed by a recurrence of the bleeding. It is thus demonstrated beyond doubt that the ureter has been completely plugged and the hemorrhage checked until shrinkage of the clot has loosened its hold and allowed of its expulsion from the canal.

Some years ago I happened to be examining with the cystoscope a patient who had suffered from profuse hæmaturia, but in whom the bleeding had ceased abruptly three days before. I was able to demonstrate the right ureteral opening to a large number of medical men. Partially extruded from that orifice and plugging it could be seen a long, gray, twisted clot. The patient himself had noticed that the reappearance of every attack had been heralded or had been accompanied by the presence of a long cylindrical black or grayish clot. To make the chain of evidence complete, I introduced an evacuating catheter, directed its eye toward the right ureter, and applied the aspirating ball, then with a slight suction movement swept the clot into the bottle. On immediately reinserting the cystoscope, streams of scarlet blood could be seen jetting out of the uncorked orifice. I removed the kidney then and there, and found a small carcinomatous growth ulcerating into the pelvis.

But clots forming in the ureter are sometimes like thin red fishing-worms, and concerning these there must be some uncertainty, for similar clots, though perhaps flatter and thicker, are moulded in the prostatic urethra.

Axiom: "Large, irregular-edged, *scarlet* clots are derived from a bladder source if traumatism of the kidney and renal tumor are excluded."

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* I have several times had a specimen sent me by medical men inquiring if it was a Strongylus Gigas worm. In the light of such a request it is suspicious to see quoted in the French literature the case of a patient "who passed a Strongylus Gigas from an enlarged kidney which subsequently became carcinomatous."

I have seen enormous clots of scarlet hue evacuated in cases of renal growth, so large indeed as to make one wonder that the urethra allowed of their transit, but these cases are uncommon, and usually the clots from carcinoma of the kidney are much darker. They are often described by those of the commoner class as being like blocks of bullock's liver.

Gelatination of Urine.—The late Professor Ultzmann[1] called attention to a condition of urine which he termed *fibrinuria*, and which he considered an important diagnostic feature in villous growths of the bladder. The urine, on being passed, is of a reddish-yellow color; it coagulates almost immediately into a jelly-like mass. Such urine does not contain much blood, as shown by its color; hence the coagulum is not in proportion to the quantity of blood present in the urine.

Ultzmann's theory of the production of fibrinuria is that the spasmodic contraction of the bladder checks the blood returning from the villi, and the vascular loops, therefore, become extremely turgid. If the blood pressure is very great the vessels rupture and hemorrhage ensues; if the tension is not sufficient to cause rupture of the vessels a transudation of plasma occurs, and its fibrin coagulates on the emission of the urine. This increased vascular tension also accounts for the presence of more albumin in the urine than would correspond to the quantity of blood and pus present.

Ultzmann gives three cases in which he had observed this symptom. Willis ("Urinary Diseases and their Treatment," p. 169, 1838) mentioned a case: "The urine gelatinized in the utensil, and when viewed by transmitted light was of a pale red-currant-jelly color." This condition must be rare. I have not met with a single well-marked instance in 150 cases of vesical growth.

(3) *The Time at which the Blood Appears in the Stream.—Axiom:* "Blood appearing toward or at the finish of clear urination denotes a vesical or a prostatic origin."

This is a rule which can be safely relied upon. The cause of its production is obvious. The vesical muscles form contractile planes which are situated between two vascular surfaces, an external subperitoneal layer and an internal mucous membrane. The external subperitoneal venous nets, which empty themselves into the internal iliac veins, receive the blood from the internal mucous membrane mesh, by means of vessels piercing the muscle planes. When the muscle planes contract, the external venous nets empty themselves, and are prevented by means of valves, from refilling by regurgitation,[2] but the internal meshes become more turgid with blood as the contraction increases, for their efflux trunks are compressed by the

muscles through which they pass on their way to join the external nets. The vessels underlying or abutting on any breach of surface such as an ulceration, or any thin-walled vessels such as those which form the basis of the structure of villous growths, will, therefore, have dangerous venous pressure placed upon them on contraction of the bladder. If to the force of an ordinary expulsive effort is added the extra stress of straining, the rupture of a congested, weakened, or thin-walled surface mesh is easily produced, and a little blood is expelled after or toward the end of the vesical contraction.

Occasionally cases will be encountered in which blood issues first and is followed by clear or clearer urine. Care should be exercised in accounting for this somewhat unusual occurrence. In most cases the blood will be in the form either of a darkish clot or of dark fluid blood, and the reason why it precedes the stream of clear urine is because it has dropped to the orifice of the bladder just as it would settle down in a conical urine-glass. It is, therefore, shot out first. It is no certain sign, however, of prostatic or urethral origin. In the majority of cases it is from the bladder or from a renal source. Should brightish fresh blood issue at the commencement of the stream the origin is probably urethral.

A gentleman, aged fifty-two, was sent to me by Dr. Alexander of Paignton, in the hope that the clots which he was passing originated in the urethra. They were moulded like urethral clots, and preceded the stream. There was slight smarting three inches from the meatus when they were passed. On examination a largish right renal growth was discovered, which was removed. Doubtless the clots which collected in the renal pelvis were gradually pressed down the ureter, finally dropped on to the lowest part of the bladder, and were swept away in the first part of the outrush.

Axiom: "Blood issuing from the meatus independently of micturition is from an urethral source."

(4) *On the Subsidence of the Blood in a Conical Glass.*—R. v. Jaksch asserts that "when blood-cells are intimately mixed with the urine in such a way that, though present in large quantity and deeply tinging the fluid, they do *not* form a sediment after many hours' standing, it may be inferred that the hemorrhage took place in the substance of the kidney or in the renal pelvis or ureters. If, under these circumstances, they are seen with the microscope to be profoundly altered, having lost their coloring matter and presenting the appearance of pale yellow rings, the further conclusion results that the blood has been effused from the kidney itself, and the symptom points to acute nephritis or to a fresh exacerbation in the course of chronic nephritis."

Qualification: Dr. James Tyson[4] has pointed out that in some cases of alkaline urine a true hæmaturia may in the course of a few hours become a hæmoglobinuria from the solution or disintegration of the red blood discs. This especially takes place in warm weather. In fact Dr. Tyson has known urine to be sent from southern parts of the United States, which when shipped contained blood corpuscles, but which when received in Philadelphia contained no blood discs, only large amounts of blood-coloring matter. Such a condition would render v. Jaksch's rule inaccurate.

(5) *The Relationship between the Hæmoglobin and Albumin.*—Newman has shown that the relationship between the quantity of hæmoglobin and the amount of albumin in the urine aids greatly in determining the seat of the hemorrhage. "Thus if the quantity of hæmoglobin and the amount of albumin determined by one or other of the recognized processes be compared, and if the ratio of albumin to hæmoglobin is as 1 to 1.6, then it may be concluded," says Dr. Newman, "that the appearance of albumin is entirely due to the presence of blood; but if the quantity of albumin is much increased beyond the proportion just mentioned, the indication is in favor not only of an independent albuminuria, but also points to a renal affection as the cause of the hæmaturia."

(6) *Absorption Test.*—It has been pointed out by Ultzmann that if potassium iodide solution is injected into the bladder, it is absorbed if any abraded surface exists and can be detected in the saliva. If there is no absorption of the iodide, it can be inferred that the continuity of the vesical mucous membrane is intact.

(7) *Microscopy.*—Blood Casts: The presence of blood casts gives an accurate clue to the origin of the hemorrhage. I have met with one case of severe paraffin burn of the whole body in which the patient passed an ounce of perfect blood cylinders in eight ounces of secretion. The cylinders fell at once to the bottom of the conical glass, and presented a very curious appearance. Death took place in a few hours. The kidneys were turgid with blood and in the first stage of nephritis.

Granular Casts: The presence of granular casts in the urine points in most instances to the kidneys as the source of the hemorrhage.

Growth: It is not an uncommon event (recorded in 19.3 per cent. of vesical tumors) for the patient to pass visible pieces of growth. I have met with fragments which varied in size from a pea to a necrosed mass half the length of the little finger. Probably in most cases microscopic pieces are passed, chiefly consisting of the villous processes. These, though they indicate a tumor, do not definitely settle the character of the growth.

Forty-one per cent. of vesical carcinomata have a surface-covering of villous processes, while in half the cases of villous cancer villous papillomatous growths of the *pure* type apparently produced by irritation coexist in the bladder with the carcinoma (Author, Pathological Society Transactions, 1888, Vol. XXXIX., p. 180, and Jacksonian Prize Essay, p. 144); 17 out of 46 cases of *single* carcinomatous tumors had villous coverings; eighteen out of 36 *multiple* carcinomatous tumors had villous surfaces. Pure villous tufts coexisted in one-sixth of the cases of sarcomatous tumors, and one-fourth of the epitheliomata.

Eggs of the Bilharzia Hæmatobia (Distoma Hæmatobium): The yellowish, well-defined egg, furnished with its terminal or lateral spine, is readily recognizable.

B. Examination of the Patient for the Source of Hæmaturia.

Physical Examination.—The physician will do well to make a thorough examination of all accessible parts of the urinary tract before instituting any instrumental exploration as to the cause of hæmaturia. I hold very strongly that it is culpable for instrumentation of any form to be carried out before all other methods of research are exhausted. My reasons for this hard and fast rule will be given subsequently.

Kidneys.

The renal region must be palpated to ascertain the existence of any undue tenderness, enlargement, or displacement of the kidneys. Israel's method of palpation is a very satisfactory one. A line parallel with the middle line of the abdomen is drawn from the middle of Poupart's ligament to the margin of the ribs. The finger-tips, placed two finger-breadths below the margin of the ribs and upon this line, are directly over the lower extremity of a kidney in place. In order to feel this kidney we must avoid poking with eager hooked fingers, or the abdominal muscles will contract in resentment. The tips of the straight extended fingers are placed upon the point indicated while the patient lies supine, with flexed legs, upon a hard bed or table. The other hand now lifts the loin gently toward the opposed fingers. At each expiration which the patient makes the fingers upon the abdomen are pressed a little farther toward the kidney, the impressions of touch being kept well in mind. It is not long before the fingers easily recognize the object sought for. If the patient now takes a full breath, a wandering kidney will be forced far under the finger-tips.

Tenderness.—Rough palpation elicits varying degrees of pain in any kidney which has some portion of its substance inflamed. Simple or ulcerating pyelitis, chronic abscess of the kidney, inflamed cyst, acute suppurative nephritis,—in all these, tenderness can be elicited by *deep* pressure. It is a mistake, then, to consider that pain can be evoked by palpation only when stone is present. I will admit that, in most cases of long-standing of stone imbedded in the cortex or a deep calyx, or in cases of stone in the pelvis large enough to press apart the walls of this cavity, there is a characteristic stabbing pain on percussion over the front of the kidney, but this "stab" is not elicited in all cases of renal calculus by percussion. Its absence, therefore, does not exclude stone. The inflamed kidney always tends to be drawn upward under the ribs. This change of position must be allowed for in palpation and percussion.

Enlargement.—In unusually thin people the tail or lower end of the kidney can be easily examined. But a kidney which is not markedly movable and which can be readily felt in its entire extent by the palpating fingers is abnormally large. It may not be diseased but merely hypertrophic, for it has often been demonstrated that when one kidney is atrophied the fellow-gland has become correspondingly enlarged in doing double duty. Perceptible enlargement of the non-mobile kidney without a history of a previous traumatism to the opposite loin, coexisting with blood in the urine, is a condition which should at once arrest attention.

The questions raised by enlargement are: Is it a tough kidney irritated by the presence of a large stone? Is intermittent hydronephrosis present? Are tubercular changes in progress? Is it a growth; a carcinoma or sarcoma; or is the kidney merely mobile?

It is noteworthy that calculi, even those of large size, sometimes remain latent in the kidney except for an occasional hæmaturia. I believe this mostly happens in the young adult. Primary chronic tubercular disease of the kidney is a disease occurring usually after twenty and in patients with a family history of phthisis. The kidney, before perinephritis has set in, is hard, rounded, smooth, usually movable, and very tender. It rarely, in my experience, reaches the size of a large closed fist without inducing inflammatory adhesion and thickening around it. This fixes the kidney and draws it slightly upward under the ribs, whence it is pushed downward in the third and last stage by abscess accumulation—a grade marked by elevated temperature and other signs.

Sarcoma of the child's kidney is too rapid in its growth and too characteristic to require notice. The *uninflamed* sarcomatous and carcinomatous tumors of the kidney (in patients over forty-five years

of age) are usually large, smooth, insensitive, and movable long after the hemorrhage has appeared, unless an injury has started the hæmaturia in the earlier stages.

It sometimes happens that a kidney is so freely movable behind the peritoneum that its excursions may occasionally kink the ureter and produce intermittent hydronephrosis. When the attack consequent upon the backward pressure subsides by the straightening of the ureter, blood may appear in the urine.

Ureters.

The examination is to be carried along the track of the ureters by deep palpation in order to ascertain if tenderness exists along the length of these channels or in definite patches. It is especially necessary to make deep pressure over the point where the ureter turns over the brim of the pelvis, for it is here that calculi sometimes lodge in their transit, and they may produce considerable hemorrhage by ulceration.* Moreover, a diseased ureter is best examined for tenderness against a bony background. The lower section of the ureters should now be examined per rectum or per vaginam in the knee-and-elbow position. This is best done after the bladder has been voluntarily emptied. Calculi have been discovered in the female by this means and removed by an incision through the vaginal roof; and in the male the opportunity is now afforded of examining the base of the prostate and vesiculæ seminales for enlargement.

Base of the Bladder.

Any hardening or thickening in the bladder base can be detected by gentle examination with the finger. I consider it very necessary to insist upon the caution that all digital examination must be gentle, rapid, and purposive. I have several times witnessed a slight vesical bleeding increased to grave and uncontrollable hemorrhage by rough examination per rectum. Probably the undue finger pressure has split the thick but friable structure of the base of the growth and laid open its vascular channels. I have seen cases of large encapsulated vesical calculus pass through very dangerous renal reaction with high temperature after prolonged rectal examination. I have, moreover, known vesical and renal tubercle decidedly worse for energetic examination with the fingers. The most common cause of thickening after the age of forty-five is carcinomatous infiltra-

* I have seen very severe hemorrhage from this cause, necessitating nephrectomy. The calculus was felt in the ureter at the pelvic brim. The patient (a lady) did well.

tion. This is usually felt at one or other side of the base in the earlier stage because the growth generally commences near one or other ureter. It is almost conclusive if examination of a dense hard plaque by the rectum is followed by a sharp hemorrhage from the bladder, testifying that the carcinomatous surface toward the bladder has been split by the pressure of the finger.

Two other forms of definite hardness of the bladder base may be encountered, one localized, the other diffused. The former is due to encysted stone, in which the finger feels the round stone through the thinnest of thin partitions, the walls of the sac; and the latter—the diffuse hardness which coexists with tubercular testicle—is due to one or other of the vesiculæ seminales (rarely both) being transformed into a long, flat, hard cake of tubercular material.

Prostate.

The prostate should be mapped out with the finger into its two lobes and the intervening sulcus. Dense localized hardness of the adult prostate is due to the presence either of tubercular deposit or of stones which have replaced the prostatic tissue. There is rarely much difficulty in distinguishing between the two. The tubercular deposit occurs most often as a small projection the size of a monkey nut situated in one or other of the lateral lobes. The corresponding epididymis in many cases is affected previously. It is stated that the prostate lobes are shotty in cases of tubercle of this organ. The many-small-shot-like feel is much rarer than the defined mass.

Prostatic calculi which can be felt per rectum are always multiple and can be made usually to grate on one another. They are, moreover, much harder than the tubercular deposit.

At or about the age of fifty the prostate may take on carcinomatous degeneration or enlarge from senile changes toward the rectum or bladder or both. Carcinoma is usually detected at once by the irregular, dense, diffused stone-like feel of the gland; senile changes invariably exhibit a uniform enlargement and more or less elastic resistance to the finger. It should be remembered that a full bladder in the stooping posture flattens the prostate and gives it a fictitious hardness.

It is wise at this time to examine the bladder bimanually, the patient being still in the knee-and-elbow position; the fingers of the left hand are placed on the pubes and an attempt is made to approximate them to the finger in the rectum or vagina. By this means any pronounced hard growth in the bladder from the lateral wall or apex may be recognized.

Testicle.

The vasa deferentia are to be searched for the bead-like deposit of tubercle, and the epididymis (the globus minor especially) should be examined for a similar infiltration.

Any sudden onset late in life (after forty-five) of a varicocele is to be regarded with suspicion as indicating malignant disease of the corresponding kidney.

Instrumental Exploration.—Various methods have been devised to ascertain whether the hæmaturia has originated in the kidney or in the bladder, such as those suggested by Pawlik, Silbermann, Polk, Tuchmann, Glück, Harry Fenwick. Most of these procedures can only be employed by their originators. Since the introduction of electric cystoscopy those which were accounted as serviceable in the main are now relegated to obscurity. Any instrumental exploration of the bladder by means of the catheter, sound, lithotrite* (Thompson), aspirator (Chismore [9]), or sharp curved curette (Kuster), is inexpedient, unnecessary, unsurgical and unsafe in all cases of *hæmaturia unaccompanied by other symptoms of urinary disorder*. If any instrumental examination is necessary in this class of cases, let it be a gentle, well-educated cystoscopy, and let the examination be made without undue haste to proceed at once to any operation which the electric light may indicate as being necessary. I would emphasize this statement by asserting that I recognize no disease of the urinary organs in which bleeding is a prominent symptom which necessitates the routine use of sound or catheter for its detection, and I know of no urinary disease which may not be materially aggravated by the employment of these instruments. I speak thus strongly because the existence of stone in the urine suggests at once to the mind of most practitioners the use of the calculus sound. Now this instrument is useful only in a very limited class of cases, viz., that of stone in the bladder; and, as I shall point out immediately, hæmaturia is very rarely the sole symptom evoked by a calculus. Even

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* Sir Henry Thompson suggests pulling pieces of growth off the main mass by means of a light lithotrite ("Vesical Tumors," British Medical Journal, 1890, ii., p. 332, foot-note). If the microscopy of pieces of growth removed by means of operation is a tragic farce as regards the real character of the growth, still less will the true nature of the growth be shown by a microscopic examination of these villous tags. Cf. Case 8, Sir H. Thompson, "Tumors of Bladder," 1884, p. 103. The growth, "bitten" or "chewed" off at the operation, was reported to be "composed of normal bladder tissue, fimbriated papillæ abundant; no structure resembling malignant growth was found," but the patient "died two months after with secondary malignant growth in thigh."

then sounding had better not be done until all preparations for simultaneous litholapaxy have been completed.

My reasons for opposing all forms of instrumentation in *symptomless* hæmaturia are as follows: I have known the use of the catheter and washing to cause death in three cases of renal carcinoma in the course of a single week. I have seen it induce fatal suppression in renal tuberculosis; dangerous pyelitis and cystitis in cases of vesical growth; I have known it gravely aggravate cases of granular nephritis, cause acute renal abscess in vesical tubercle, and produce death in cases of vesical stone coexisting with advanced but unsuspected renal degeneration; I have known of deaths from suppurative nephritis, and from sloughing of vesical tumor; and I have seen retention and alarmingly profuse hemorrhages follow sounding in cases of tumor of the bladder (severe hemorrhage following upon gentle sounding points to the presence of a new growth)—in fact, my notebooks are interspersed with cases in which instrumentation in symptomless hæmaturia has brought discredit upon the practitioner and disaster upon the patient.

It is, however, quite otherwise in those cases of hæmaturia in which symptoms of vesical or prostatic disease, pain, frequency of micturition, and obstruction to the stream, have preceded the appearance of the blood. In these cases instrumental exploration is often absolutely necessary for a differential diagnosis, and if employed skilfully and judiciously it is as free from risk as is any instrumentation through the deep urethra of males. I may remark, incidentally, that the risk increases after forty-five years of age with every year; that more danger is incurred in town dwellers than in those who have led healthy out-door lives; that malaria and the various tropical fevers probably leave the kidneys less able to bear any sudden stress of reflex congestion. The urethral bougie will eliminate stricture, the sound determines the presence of stone and the intravesical enlargement of the senile prostate, while the catheter establishes at once the presence or absence of residual urine.

C. Critical Examination of the Symptoms.

In the larger proportion of cases the appearance of blood in the urine is heralded by symptoms of pain or uneasiness in the kidneys, ureter, bladder, prostate, or urethra, or by functional disturbances of the bladder such as obstruction to the stream or frequency of micturition. Such symptoms direct the practitioner's attention to the part and permit him to locate the probable source of the hemorrhage. This is, however, not always so. There are a certain number of

patients—the minority—who complain of no other symptom beyond the appearance of blood in the urine, and who assert that if they were blind or urinated in the dark they would believe themselves to be in perfect health. This circumstance allows of the subject of hæmaturia being discussed under the headings of Symptomless Hæmaturia and Hæmaturia with Symptoms, and to establish these very obvious classes the practitioner must tactfully elicit the exact character of the onset symptoms.

I hold that an accurate history of the character of the onset of the urinary symptoms is one of the most important factors in shaping the diagnosis of the site and cause of the bleeding.

But there are other atoms which go to form the molecule of accurate diagnosis, and these also should be included in a preliminary consideration of each case. The age, the sex, the pre-existence or coexistence of grave constitutional disorders, the exhibition of drugs, errors in diet, the occurrence of direct or indirect violence, all these, though in themselves of but slight diagnostic import, are factors which prove of value in forming rapid conclusions.

Sex.—Hæmaturia is uncommon in the female. When it occurs in the young adult before marriage, and urethral carbuncle is eliminated, vesical ulceration of a tubercular type ought to be considered. If it occurs after marriage and before the age of forty, a careful examination of the uterus should be made, for this organ is often at fault. As a result of dragging by the uterus on the bladder or of the extension of inflammation to the base of that organ cystitis is common. The bladder is frequently affected by carcinoma propagated from the uterus. Vesical stone is rare, but inflammatory renal mischief from ascending pyelitis is comparatively frequent. Males are much more prone to hemorrhage from all parts of the urinary tract. This is probably due to their greater exposure to accidents and to the sequelæ of venereal diseases. Primary growths of the bladder occur five times more often in man than in woman, and I believe the young male is more often affected than the female with tuberculosis and renal stone.

Age.—Before five the causes of hæmaturia are more commonly those due to scorbutic troubles from dietetic errors; renal concretions come next, while sarcoma of the kidney and myxosarcoma of the bladder are very rare.

Between puberty and twenty, tubercle of the bladder and renal stone furnish the larger proportion, but prostatic congestions due to excessive masturbation or venereal indulgence are not to be forgotten.

Between twenty and thirty, prostatic congestions due to gonorrhœa

or leucorrhœal urethritis, urinary tuberculosis, chronic Bright's disease, villous papilloma, and vesical stone are met with.

Between thirty and forty, stricture (rare), and vesical papilloma.*

After forty, vesical papillary growth with a tendency in the base to become carcinomatous.

About and after fifty, renal growth, prostatic hemorrhage, vesical stone, and carcinoma of the bladder are the usual causes for hæmaturia.

Grave Constitutional Disorders.—Blood in the urine appears in the course of some malignant fevers, in measles, small-pox, typhus fever, septicæmia, or after cholera (Prout). The appearance of blood under these circumstances is considered as a very grave sign indeed, but of the renal origin and cause there is no doubt. It is also not uncommon in malaria and scurvy. Lastly, evidence is slowly collecting of a distinct and exhausting renal hemorrhage which occurs in cases of the hemorrhagic diathesis.

After Certain Forms of Diet.—Certain articles of diet are known to produce hæmaturia if indulged in too freely, or if taken by persons of gouty habit, or by those who have a special idiosyncrasy. Thus the common or garden rhubarb[6] may produce a sharp attack of hæmaturia, with frequent and painful micturition, more or less pain in the loins, and general indisposition. The blood emanates doubtless from the kidneys in these cases. Hard drinking-water, supplying the lime for the oxalic acid of the rhubarb to combine with and form oxalate of lime, is suggested by Dr. O'Neill as being a necessary factor.

Some fruits, such as gooseberries, unripe apples, and certain species of strawberries, are credited with the same powers.

Although asparagus is known as a diuretic,[7] it is not, I believe, generally supposed to induce hæmaturia. Mr. Reginald Harrison[8] has, however, mentioned the occurrence of two cases of this kind in his practice.

Other vegetables and some fruits † color the urine like blood, but there is deficient evidence as to whether they actually cause bleeding.

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* It is especially as regards vesical growth that the age is a valuable indication. Thus for villous papilloma in 25 cases, the age in decades and the cases met with were as follows: From 20 to 30, 3 cases; 30 to 40, 5 cases; 40 to 50, 10 cases; 50 to 60, 6 cases; 60 to 70, 1 case—25 cases.

The age for carcinoma in 50 cases: 32 to 39, 3 cases; 40 to 50, 7 cases; 50 to 60, 25 cases; 60 to 70, 12 cases; 71 to 87, 3 cases—50 cases.

† Beetroot: "Desault relates the case of one who noted his morning urine was of a bright blood-red color. He consulted M. Roux. It was found that he eat red beetroot every night for supper." Logwood and madder have the same effect. The prickly pear (*Cactus opuntia*): "When the Spaniards first took America many of them were alarmed by observing that they were passing what they supposed was

After exhibition of certain drugs.* Cantharides and turpentine are the two chief drugs which excite hæmaturia. They cause so much renal or vesical congestion as to produce the escape of blood. The former, being a constituent of certain quack aphrodisiac medicines, is not an uncommon evoker of hæmaturia. Spanish-fly blisters produce similar results in patients who are sensitive to the use of cantharides. Mr. Shalford Walker brought before the notice of the Liverpool Medical Institute in 1866 the history of a whole crew of a ship carrying a cargo of turpentine being affected during the voyage with hæmaturia, and in one case a fatal result followed. Mr. Harrison suggested that this was due to inhalation.

Diagnostic Significance of Hæmaturia following Slight Indirect Violence.

The hæmaturia of injury does not require notice. The injury is direct, the history of the blow is generally obtained, and the locality is usually obvious, but certain valuable hints may be obtained by eliciting from the patient facts concerning the influence of *slight indirect violence* upon the production of the initial hæmaturia.

If a slight indirect traumatism, such as a fall on the buttock, has produced in a youth or young adult a symptomless renal hæmaturia, which continues or intermits, it is probable that some pre-existing disease such as latent renal stone or chronic Bright's disease was present, and is now responsible for the obstinate persistency of the bleeding. In these cases the urine may reveal traces of the disorder in the shape of crystals or of casts, low specific gravity, and albumin.

In patients over forty (an arbitrary age depending upon statistics), with unsuspected softish growth of the urinary tract, it is often a light strain which appears to be the cause for the first attack of the hemorrhage. Some affirm that they feel or hear something "snap" or "give way" in making some slight exertion, such as lifting an article of furniture. In six of seventeen cases of malignant disease of the kidney which have been under my observation, some slight indirect violence had obviously induced the bleeding. In one-third of

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bloody urine. It proved to be due to the liberal use of the prickly pear." Dr. Hennen ("Military Surgery") quotes from Ellicot's Journal of his "Travels for Determining the Boundary of the United States:" "People ate very plentifully of this substance (prickly pear) at an island of the Mississippi (Kayoani), and were not a little surprised the next morning at finding their urine appear as if it had been highly tinged with cochineal. No inconvenience followed."

* Rhubarb and senna in alkaline urine impart a red coloration to the urine. It is removed by adding acid, and returns on overcoming the acid with alkali. Analgen colors some urines a cherry-red.

the cases in the list of soft vesical growth the initial hemorrhage had apparently some direct relation to a slight indirect traumatism. In two of the fifteen cases of carcinoma of the prostate the bleeding followed immediately on indirect violence. The small number in the latter group probably depends on capsular protection.

Should, therefore, a slight strain or a decided extra exertion be immediately or almost immediately followed in an adult over forty by a smart attack of hemorrhage, a friable pre-existing growth should be suspected to exist. It might be argued that the slight traumatism has been followed by a new growth; and that it stands to the growth in the relation of cause and effect. Not so. Though it is beside the question before us, I may remind the reader that the cystoscope has taught us that soft malignant tumor of the bladder may grow latently, unsuspected by either the practitioner or patient, and that cases have been examined within a week or so of the onset of hæmaturia and the growth then discovered; hence the onset of hæmaturia does not herald the birth of a growth, but usually denotes a tear or degenerative change in the surface of one already formed.

Benign growths do not seem to be so often affected in this way, though when they have attained a large size they will often bleed upon some extra exertion being taken by the patient.

I account for this difference in the behavior of malignant and non-malignant tumors when roughly shaken, by the structural differences of the stalk or base of these two varieties of growth, that of the benign type being less rigid and less friable than the malignant—for it is composed of tissue more approaching the normal in character. I would suggest that the surface of a purely benign growth, *e.g.*, when covered by villous processes, is much less damaged by the succussions of the water in the bladder than is the easily tearable neoplastic base and surface of a carcinomatous tumor, for the latter is soldered on to the wall, and the attachment has to bear the strain of the stretching of the adjoining muscle as it yields before the momentum of the urine or bends before the compressing force of suddenly exerted intra-abdominal pressure. My judgment has been often biased in favor of a malignant growth being present, when I have found that the *onset* hæmaturia was apparently the result of slight indirect violence.

The Diagnostic Significance of the Effects of Rest, Abrupt Movements, and Exercise, during the Course of a Case of Hæmaturia.

The hæmaturia of stone in the kidney pelvis, in the bladder or prostate usually subsides upon rest being taken in the recumbent posture. In all cases in which the subjacent mucous membrane is

not ulcerated the bleeding is established or aggravated only by abrupt movements or exercise.

It, therefore, stands as general rule that when the hemorrhage is noticed to increase toward night-time and to be found diminished on rising in the morning, and when pain and irritability of the bladder increase and decrease in the same proportion and under similar conditions, a stone is the probable cause of the bleeding.

It must, however, be remembered that occasionally exercise has the same effect in increasing the bleeding of hard carcinoma of the bladder, large villous growths of the bladder, tubercular ulceration of the bladder, and large senile prostate.

It is noticeable that when hæmaturia persists in spite of prolonged rest it is usually from ulceration or morbid growth. Thus carcinoma of the bladder or kidney frequently bleeds most at nights, —the hemorrhage rather diminishing during the day.

Symptomless Hæmaturia.

The diseases which usually evoke hæmaturia before inducing pain or any other concomitant symptoms of urinary trouble are those which lie latent and unsuspected until the effusion of blood draws attention to the urine and provokes investigation. Thus there is every reason to believe that renal carcinoma or sarcoma, contracting granular kidney, villous or soft carcinomatous growths of the bladder when situated at a distance from the urinary outlets, and rare cases of renal and vesical stone exist for variable periods before a chance congestion, an extra exertion, or some slight indirect violence evokes the hæmaturia which discloses their existence.

It is always difficult to group diseases with accuracy on the basis of single symptoms, but the following table roughly differentiates the causes of the symptomless variety:

Onset sudden. Course intermittent. Painless for months.*	*a.* Renal.	Blood usually profuse and bright; intimately mixed.	Malignant disease of kidney.
	Renal tenderness.	Blood moderate, but bright; intimately mixed.	Granular kidney; renal syphiloma; cardiac disease; rare renal stone.
	b. Vesical.	Blood usually intimately mixed, but probably noticed pure at end of clear micturition at some time or other in course of case.	1. Sessile or short-pedicled benign growth away from orifice of urethra. 2. Epitheliomatous tumor of posterior wall or sides. 3. Rare vesical stone.

* The pain due to the passage of renal and vesical clots is not of course taken into account, being merely temporary and of mechanical origin.

In all these cases it will be noticed that the onset of the bleeding is sudden, and often spontaneous; that it is intermittent in its appearance, the urine between the hemorrhages being *absolutely* normal, with the exception of that passed in granular kidney, and, lastly, that no pain is experienced in the earlier stages in the region affected.

The Renal Group of Symptomless Hæmaturia.

The renal group, which includes renal cancer, syphilis, Bright's disease, congestion due to cardiac disease, and rare cases of renal stone, can only be separated from the vesical group, in the absence of a cystoscopic examination, on clinical grounds. These are frequently unsatisfactory. They consist for the most part in a careful and critical estimation of all the onset symptoms and a thorough examination of the patient on the lines just laid down. Much stress, as will be seen by the table, is placed upon the more perfect admixture of the urine and localized renal tenderness on pressure. The characteristics of those grouped together as renal are as follows:

*Malignant Disease of the Kidney.**

Our knowledge of the varieties of malignant diseases of the kidney of the adult is at present inexact; the clinical picture of the disease must, therefore, be uncertain. The commonest form of malignant disease in the adult kidney is encephaloid cancer, but it has been lately proved that sarcoma of the capsule of the kidney, as well as of the suprarenal body, is also not infrequent. The cases recorded of the latter diseases are too few in number, however, to settle definitely as to whether hæmaturia is a delayed symptom in these sarcomata or not. I believe that in sarcomatous cases a renal tumor is discovered before blood appears in the urine. In children, in whom probably most renal growths are sarcomata, the tumor is usually recognizable before the hæmaturia ensues. Thus Lebert, who has collected over fifty cases, notes that in thirty-six cases a renal tumor appeared first; and in nineteen cases hæmaturia was the first symptom.

Character of Hæmaturia in Malignant Disease of the Kidney in the Adult.—Onset: The patients are mostly men about the age of fifty. The ages of my cases were 64, 53, 53, 54, 44, 52, 42, 45, 4, 54, 62, 51, 49, 52, 60, 49, 47. In the large majority of patients whom I have seen there has been no warning, previous to the hemorrhage, that the kidney was diseased. In six cases out of seventeen the hemorrhage has been sudden, unexpected, and profuse, following almost directly upon some form of violence, such as a blow on the loin (two cases); severe exer-

* Hæmaturia occurs in 50 per cent. of renal carcinoma (Ebstein).

cise (one case); severe coughing (one case); lifting a heavy weight (one case); bending down to open the lowest drawer of a bureau (one case). In the remaining eleven cases the hemorrhage has been spontaneous and usually bright in character at the very commencement. In all cases rest in bed has promptly checked the bleeding, but on the patient returning to active habits it has recurred, sometimes to an alarming extent. Even travelling in a jolting conveyance or a train has reinduced the hemorrhage. Clots of two forms appear early, or occasionally in the course of the disease—either the massy irregular clots which are formed in the bladder from the arterial blood poured into that viscus along the ureter, or the long finger-shaped, worm-like clots, which are the casts of the ureteral canal. I have seen these long clots only after traumatic rupture of the kidney and in malignant disease. I believe they are rarely noticed in any other form of renal hemorrhage. Specimen No. 3601 A in the museum of the Royal College of Surgeons shows a right kidney laid open longitudinally to display a large branched clot which in the recent state filled the pelvis and calyces and extended several inches down the ureter. The right renal vein was thrombosed, but the corresponding artery was patent. This specimen was removed from a woman aged thirty-six, whose urine became albuminous but not bloody shortly before her death, which occurred suddenly from pulmonary embolism. In rare instances the ureteral casts have been found to be composed of sarcoma cells and blood (St. George's Hospital Museum, 42 C). Another case is recorded by Penrose.[10]

The bleeding often ceases abruptly, the water being heavily charged with bright red blood on one evacuation and at the next it is crystal-clear. This sudden change is due to temporary corkage of the ureter with a long vermicular clot. This clot will probably be gradually decolorized and expelled at some subsequent urination in the shape of a worm of a whitish fawn-color, or even buff-colored or black. Of all renal hemorrhage, that which proceeds from a growth is by far the most alarming. In some cases it has been so profuse as quickly to blanch the patient, and to render him breathless on the slightest exertion; in one case the patient was blind for some days from retinal anæmia. The urine is colored variously from the admixture of blood, the color of thick cocoa or porter, dark red, bright arterial—in fact, every variety, with the possible exception of tarry bleeding of malignant malaria, is simulated. Yet, notwithstanding this change of front, the urine will be usually clear between the attacks, of fair specific gravity, and contain only a trace of albumin.*

* Thiriar has stated that urea is diminished in malignant disease of the kidney.

The profuse hemorrhage of renal carcinoma is sometimes rivalled by that of vesical malignant growth. In the latter, however, cystitis and the necrosis of the growth rapidly supervene and produce a typical stinking urine, which condition is never noticed, I believe, in renal cancer unless the practitioner has introduced septic material by catheterism, sounding, or injudicious washing.

Pain.—Mild renal colic may arise from transient impaction of a clot in the ureter, and a guide to the kidney affected is at once established; but the pain ceases directly the clot is expelled into the bladder, and the shape and appearance of the coagulum in the urine interpret the cause and character of the renal suffering. When the clots in the bladder are large there may be some difficulty and straining in evacuating them; nay, there may be even temporary retention, but when the clots are evacuated the vesical colic subsides. With these exceptions and that of the hæmaturia, renal carcinoma is usually a symptomless affection at first. Of those patients who have been under my care not one had pain beyond a slight backache and feeling of lassitude, due to the excessive loss of blood for the first nine months. Pain in the back was, however, induced as the growth progressively increased and involved the surrounding structures. The hemorrhage, probably by depleting the vessels and relieving tension, usually lessens the pain in the later stages.

Pain is, however, experienced if swelling from nephritis ensues. In two cases not included in the above I have known great pain produced by septic inflammation of the carcinomatous kidney. In both cases I believe that the acute suppurative nephritis was the result of catheterism, and death occurred in the very earliest stage (compare section on Treatment).

Tumor.—Probably the very large renal tumors are sarcomatous. The true carcinomata rarely reach a large size without causing much pain and constitutional effects.

Varicocele occasionally appears in the later stages of renal cancer, and is a very important additional evidence of impediment by pressure of a malignant growth; so much so that if a varicocele suddenly makes its appearance in a patient about the age of fifty it imperatively calls for an immediate examination of the kidney of the corresponding side.

Frequency of micturition apart from that temporarily induced by clot retention * is not common. Obstinate constipation, flatulence, and other digestive troubles are often complained of.

Malaise and cachexia are noticed in rare instances even before the

* I have known retention ensue without blood clot.

hæmaturia or tumor, and are to be regarded as an ominous sign of dissemination. Usually the cachexia is due to loss of blood in the earlier stages.

Typical Cases of Renal Carcinoma.

CASE 1.—G. W., æt. 44, under Mr. McCarthy. Twelve months previous to coming under my observation the patient, being in perfect urinary health, was lifting a moderate-sized weight when he felt something snap in his left side. He passed a large quantity of liquid blood. The hemorrhage was arrested by a week's medicine and rest in bed. It recurred upon his going back to work, and large worm-shaped clots came away with the urine. Since this recurrence, the character of the attacks has always been the same. The hemorrhage is profuse—in some instances alarmingly so, but rest in bed checks it. On resuming his occupation the blood returns with great violence. No pain and no frequency of micturition were noticed. The day I examined him with the cystoscope the hemorrhage had completely ceased.

Cystoscopy.—Bladder healthy throughout. Left ureteral orifice is marked by a red blush, the lips are pouting; right ureteral opening healthy; prostate small; no renal tumor; diagnosis, probably left renal carcinoma.

This occurred in the early days of electric cystoscopy, and as my incomplete diagnosis did not satisfy one of my colleagues, I had the patient watched. He became "blind" for four days in Seabrook Ward, Hemel Hempstead Infirmary, from excessive loss of blood, and finally drifted into the Infirmary in St. George's in the East, under Dr. Harris, where he died.

Dr. Elwin Harris, to whom I applied for a record of the autopsy, very kindly wrote me a letter about the patient (dated October 13th, 1891), in which he says: "George W. was a case of profuse hæmaturia, which I erroneously diagnosed as malignant disease of bladder. I well recollect my surprise at finding the bladder quite free from disease at the post-mortem. I signed the certificate 'Carcinoma of kidney.'"

CASE 2.—B., æt. 52. About a year previous to this patient coming under my observation he passed a clot of blood "like a fly." For fourteen days he was free and then another clot appeared. About this time he remarked that he was losing his elasticity of spirits, that he tired easily and was glad to sit down and rest. A month after the appearance of the clot, a short railway journey having been taken, he was seized with retention. A catheter was passed and much difficulty was experienced in clearing the bladder of many large black clots. He remained free from all symptoms for two and a half months, when he had a similar attack of retention. Again there was an entire absence of symptoms until one day he noticed a constant desire to micturate, which he complied with. Every ten or fifteen minutes he passed without difficulty a little clear water. Accompanying this was the greatest sense of discomfort and miserable restlessness. He did not know whether to sit down or stand up. This continued for an hour or two, when he drank a quantity of hot tea

and immediately obtained relief both from the pain and from the constant desire to urinate. Shortly afterward he passed a long piece of tissue which was pronounced to be a worm but which really turned out to be a ureteral clot. He never suffered from these uneasy symptoms again. He has noticed that he has been losing flesh and growing anæmic. A few months ago a right-sided varicocele appeared.

When he consulted me there was a well-marked hard movable right renal growth. He had no frequency of micturition and no pain. He was merely annoyed by recurrent attacks of profuse hemorrhage and obstinate constipation. There was no history of cancer in the family, but the patient had had syphilis twenty years previously and had been invalided home from India for phthisis. I advised nephrectomy, and I heard a few weeks after that the patient had taken another opinion and that the right kidney had been successfully removed.

Granular Kidney, Syphiloma of the Kidney, Renal Congestion from Cardiac Back Pressure, Rare Cases of Renal Stone.

This group of renal disorders may furnish a brightish bleeding, but rarely in sufficient quantity to cause clotting. Usually the urine varies greatly in color from a rosy tinge to the darker renal color. The urine contains evidences of renal disease in the periods of calm, when blood is absent, in the form of low specific gravity, casts, or albumin.

Chronic Bright's Disease.—The occasional brightness of blood in acute Bright's disease is of course well recognized, but I do not think that the profession at large has yet realized that a very abundant and intermittent, often brightish hemorrhage may occur in chronic contracting granular kidney. This occasional brightness is a source of fallacy. I have met with various examples, and have thought, until quite recently, that the subject had been overlooked,[11] but my attention has lately been drawn to papers on the same subject by Dr. West and Mr. Bowlby[12] which were published before my note. Dr. West gives three valuable cases, and mentions the following which came under Dr. Sharkey's care at St. Thomas' Hospital: "The patient, a young girl, passed so much blood with the urine that the bladder was sounded, and the surgeon, failing to find a stone, suggested dilatation of the urethra and the digital exploration of the bladder. To this Dr. Sharkey did not, for good reasons, consent, and the patient died. No stone was discovered in the autopsy but markedly granular kidneys."[13]

But the symptomless cases I have met with form about twelve per cent. of the obscure hæmaturias which I have examined with the cystoscope. I believe, as these cases progress, frequency of micturi-

tion and renal pain supervene, and they fall into the group of hæmaturia with symptoms (*q.v.*)

Not unfrequently the hemorrhage has ensued upon a slight strain or fall on the buttocks, and much difficulty has subsequently arisen in stating positively whether the slight symptoms of renal disease found in the urine were the outcome of the injury or preceded it. I believe in many of these cases a degeneration pre-exists, and the kidney tissue, being friable, splits more easily than healthy renal substance would have done, and heals proportionately slowly.

The cases are recognized by the condition of the urine, a low specific gravity, the presence of albumin and casts; to which may be added cardiac and retinal changes in advanced stages. These cases heal with prolonged rest and milk diet. I have recently met with a case which proved on post-mortem to be one of probably congenital cystic kidney; clinically, however, it could not be diagnosed from the contracting granular kidney except by the severe pain in the renal region.

Schede[14] of Hamburg records the following interesting case of uncontrollable renal hemorrhage:

A man, aged 50, passed bloody urine for the first time after a cold drink. He had frequently before noticed a sensation of cold in the left lumbar region. If he remained quietly in bed the bleeding ceased, but it returned directly he got up. Styptics did not relieve the condition, and the blood was proved by catheterism of the ureters to issue from the left ureter. Left nephrectomy was performed; the kidney substance was found to be very friable, and microscopical examination of it revealed what was invisible to the eye, viz., an anæmic condition interspersed with small petechiæ, and decayed cylinders covered with red blood-cells.

Syphiloma.—I have encountered undoubted cases of renal syphiloma which have been marked by a brightish hæmaturia. The bleeding in each case was controlled only by iodides.[15]

It must be stated, however, that recent clinical experience points rather to syphilis of the kidney producing symptoms of pain without hæmaturia. Thus Dr. Israel[16] reports two cases of syphilis of the kidney which occasioned a tumor:

Case 1.—A girl, aged 23, after increased thirst, stomach cramps, and frequency of micturition, suffered from continuous pain in the back which was later on localized to the right side. There was loss of flesh, and a tumor developed in the right renal region. Anti-syphilitic treatment was instituted, and appeared to give good results for a time, but as collections of flattened cells, agglomerated into rounded masses and surrounded by a species of girdle composed of fusiform cells, began to appear in the urine in the form of a whitish deposit, an exploratory incision was made, and the kidney was

found so altered that it was finally extirpated. Recovery was rapid. Examination of the kidney showed the tumor to consist of syphilitic interstitial nephritis, with hyperplastic peri- and para-nephritis.

CASE 2.—A male, aged 39, with syphilitic and malarial antecedents, complained of a continuous pain on the left side, with swelling at the tenth rib. An abscess of the spleen was thought of, and an incision was made, releasing a yellowish curdy-white material, but no pus; a fistula remained. The kidney was finally diagnosed as tubercular and was extirpated. The microscope revealed gummatous degeneration without a trace of tubercle.

Congestion in Cardiac Disease.—I have come across quite a number of cases of symptomless renal hæmaturia which I could only account for by the supposition that they were due to the backward pressure exerted by cardiac disease, but I have no post-mortem evidence in support of this view.

Rare Cases of Stone in the Kidney.—It is considered[16] that hæmaturia is the most important clinical symptom of renal calculus; and though I am inclined to dissent from this view and to place pain as the most characteristic feature of renal stone, yet I feel sure that in *rare cases* in children and young adults hæmaturia may be the only symptom in the early stages of this affection. The character which apparently stamps it is the *marked effect of exercise* in increasing or producing the bleeding. It may be that in children the pain of renal calculus is often misunderstood and that which is complained of is vaguely termed "stomach ache," and it is accepted as such by the mother and the physician. I have seen children passing blood and crystals of uric acid who were said to suffer no pain, but cross-examination elicited the fact that they occasionally complained of uneasiness and cramp in the stomach. They have subsequently passed calculi. Criticism might condemn the introduction of this group among the symptomless hæmaturias, and it would be just, were it not for the fact that in the adult hæmaturia also occasionally occurs in renal stone without other symptoms being present. In time, however, other symptoms supervene.

CASE.—A little girl was observed to pass clotted blood and urine on to the floor at the age of two. For three years the hæmaturia intermitted and was quite painless. Sometimes the urine was very bright, and at other times smoky. When she came under my observation she was a pasty-faced child five years of age with a tender right kidney. The urine was clear but deposited a thick layer of crystals of phosphate of lime. There was no frequency of urination. I advised course of lime juice and water and luckily she passed a small smooth stone at the end of a fortnight, the expulsion being preceded by intense pain in the belly. The child has since been well.

CASE.—I was asked to examine with the cystoscope a healthy

young man aged 26, in order to ascertain the source of a symptomless hæmaturia. At the age of 17 he had noticed that he passed dark-colored bloody urine after a rapid walk. It soon ceased, but it returned at rare intervals and after great exertion. He suffered, however, no pain or inconvenience of any sort. At the age of 24 he was circumcised, and after the operation he again passed dark-colored blood. The attacks of hæmaturia now became more frequent and any jolting induced the bleeding, but it was never bright. If he remained at rest the urine promptly cleared. The urine was of low specific gravity and the morning sample was quite clear, but it became murky with pus toward night. There was some tenderness over the right loin. Cystoscopy showed the bladder to be healthy in every part and the diagnosis was left open, though it was suggested that tuberculosis of the kidney might be present. I was able to follow the case for three years. Pus gradually became constant in the urine and was passed in large quantities; a distinct tumor of the right kidney appeared. Exploratory nephrotomy was performed and a large branched calculus removed.

Villous Growth of the Pelvis of the Kidney, and the Hæmaturia of the Hemorrhagic Diathesis.

Such cases as villous growth of the renal pelvis and the renal bleeding in hemorrhagic diathesis are too infrequent to need discussion. Senator[17] records a case of the latter and others have since appeared in the literature. Senator's case was the following:

A young lady suffered from long-standing, frequently recurring, and profuse hæmaturia, proved by cystoscopic examination to come from the right ureter. There was no pain and her age discouraged the diagnosis of malignant disease. She belonged to a family of bleeders, and her father and mother were cousins. As a last resource the right kidney was extirpated. The result was most favorable, as two days after the operation the hæmaturia disappeared and did not return. The kidney appeared quite normal. Senator thinks that this case suggests that in some instances hæmophilia is due to a local defect in the walls of the vessels.

The Vesical Group of Symptomless Hæmaturia.

The vesical group of symptomless hæmaturia includes sessile or short pedicled benign growths of the bladder, situated away from the urethral orifice,* soft epithelioma in the early stages, springing from the posterior wall of the bladder and occasional cases of vesical stone in males above the age of fifty. The differentiation of these three

* These constitute 92 per cent. of all villous papillomata, and the distinction is made because in 8 per cent. the hæmaturia is preceded by vesical irritability induced by the growth falling over the urethral orifice.

subsections is established by the degree of blood in the urine, the duration of symptoms, and other items which will be referred to.

The Life History of Hemorrhage from Benign Growths, which are Situated Away from the Orifice of the Bladder.

The history is often of long duration—a matter of years, not months. Usually the bleeding commences insidiously; perhaps it appears in the form of darkish clots like flies, only to disappear in a few days, or the urine may be merely discolored, or a little blood may be passed at the end of clear micturition, or the whole secretion may be of a dark coffee-color. The patient may connect the onset with over-fatigue, but I believe this is uncommon. It is also rare, as far as my experience goes, for a profuse arterial-colored hemorrhage to form the onset attack. The hæmaturia ceases as spontaneously as it commenced, but it recurs unexpectedly, causelessly, at longer or shorter intervals. As the tumor increases in size, the length of the periods of rest appears to decrease and the loss to be more profuse. The bleeding is unaccompanied by any other symptom; neither frequency of micturition, pain, nor stoppage of the stream is noticed.

The larger the tumor is, or the wider the area which is occupied by the base, the greater is the tendency for the bleeding to recur after exercise or over-fatigue. In the male, coition will sometimes induce an attack or increase the bleeding. It is usually more under the control of rest than hemorrhage from a malignant surface. Probably it will be, now and again in the course of the case, of a distinct vesical type, *i.e.*, brightest blood will appear at the finish of a stream of clear urine.

The hemorrhage is rarely of the violent arterial type, though I have known one or two patients blanched with the loss; usually it is less furious and darker. If the deeper layers of the growths become carcinomatous I believe the hemorrhage becomes more profuse and more persistent. As the neoplasm approaches the urethral orifice, either by lengthening of its stalk or by overgrowth, it is exposed to greater damage, the bleeding is more severe, and other symptoms, such as irritability of the bladder, and stoppage of the stream, also appear. Such cases will be considered in the section on Hæmaturia with Symptoms.

The hæmaturia may be checked for a time by intercurrent disease, *e.g.*, carcinoma of the breast, acute rheumatism, or some fever, but recurs after the interloper has been removed or subsides.

Lastly, when the period of cystitis is ushered in (either from change in the character of the base of the growth, or from the tumor

having begun to necrose, or from injudicious exploration on the part of the surgeon), the appearance of the blood changes, pus becomes mixed with it, and the hemorrhage may be permanently arrested by the inflammatory plugging of the vascular supply of the surface of the growth which takes place on the establishmant of severe cystitis.

ILLUSTRATIVE CASE (selected from 150 Cases of Vesical Growth).—A well-built man, aged 48, came to me with the following history. Twenty years ago, being in perfect health, he noticed that he was passing small black clumps like flies in his urine. These clots ceased. Then the urine became periodically colored with blood. The hemorrhage was affected neither by coition nor by movement, nor by over-indulgence in alcohol. For fifteen years the hæmaturia appeared off and on, causelessly, and was unaccompanied by any other symptom. Five years ago he began to experience pain on micturition of a cutting character. He referred the pain to a spot an inch down the penis on the under surface; it seized him as the bladder was just emptying. He had passed clots accompanied by a quantity of porter-like urine, and at the end pure blood had sometimes dribbled away.

Electric Cystoscopy.—On the left side of the bladder a large sessile fibropapilloma could be seen. Here and there the surface was white and necrotic. Its area occupied the left side of the base and the adjoining left lateral wall for about an inch. It encroached also slightly on the anterior wall.

I removed the tumor by supra-pubic operation.

Remarks.—It will be noticed that for fifteen years no other signs of the vesical growth existed beyond the recurrent hæmaturia. Up to this date the case falls into the group of symptomless hæmaturia. Then he commenced to experience pain and some obstruction, which symptoms were probably due to implication of the urethral outlet of the bladder.

Soft Malignant Growth of the Posterior Wall.—It will be observed that, contrary to the current teaching, vesical carcinoma is tabulated with villous growth of the bladder as being *symptomless*. It will be remembered that Sir H. Thompson [14] has indorsed the axiom enunciated by Professor Gross. He asserts: "In most of the cases in which the tumor was of the malignant type or approached thereto, pain and frequency of passing water generally preceded the appearance of blood, sometimes for a considerable period of time." I have for long been certain that this is a decided error, and submit that such a dictum laid down in pre-cystoscopic times should be abandoned.[15] Seventy-six per cent. of my cases of cancerous tumor of the bladder show it to be incorrect. A soft malignant tumor, springing from the posterior wall, may grow quietly, even latently, for months before it induces hæmaturia, and if it is so placed as to be out of the

region of the sensitive neck of the bladder it evokes neither frequency of micturition nor pain until the wall becomes infiltrated, the capacity of the bladder markedly diminished, or until cystitis is induced by the necrosis and irritation of the growth.

The Life History of Hemorrhage from Malignant Growths.

Presuming the medical man to have induced no cystitis by sounding or catheterism—and this is uncommon—the hæmaturia of soft malignant growth, situated away from the neighborhood of the ureters, may be symptomless for months, the average duration of the stage being probably nine months. After this the inevitable cystitis supervenes, or the muscle-wall becomes infiltrated, and frequency of micturition and suffering ensue.

The initial hæmaturia is sometimes slight, as in benign growths, but more often than not it is profuse, the urine being very dark or maroon-colored with clots. The patient in many instances traces it to a slight indirect violence. At first it is intermittent, its return usually dependent on exercise, its cessation upon rest, but it rapidly loses these characters. It becomes more or less persistent, and is not so easily affected by drugs. The urine acquires the characters of the washings of flesh and becomes offensive. The color becomes changed by the alkalinity of the urine; muco-pus, débris, and phosphatic grit appear in the secretion.

In order to distinguish between these two classes of hæmaturia, that due to benign and that the outcome of malignant growth, a careful rectal examination of the bladder is to be undertaken. If any hard infiltrated area is discovered in the base of the bladder behind the prostate, the growth is almost certain to be a carcinoma and not of a benign type. If with this there is constant pain, if the patient is of an age above forty-five, if there has been loss of flesh, if malaise is present, and finally if a history of family carcinoma, phthisis, or longevity, is obtainable, the suspicion of malignity is much strengthened.

Type of Soft Succulent Epithelioma.—The following cases were recorded[20] while the patients were alive. A post-mortem examination has subsequently been obtained, so that the histories are now complete.

Hæmaturia, Cystoscopy Revealing a Russet-Gray Growth and an Altered Mucous Membrane; Removal of the Former by Suction, and Development of Cancer in the Latter.—Mr. O., æt. 56 (under Mr. Travers Stubbs). Five weeks before consulting me, being in perfect urinary health, he suddenly and without warning passed a quantity of

coffee-colored urine. He suffered no pain, but had a tenderness in the right testicle. Since this time the urine has varied in its aspect; now and again it has been quite clear for a day or two, then it has become very dark.

On passing the cystoscope, a peculiar russet-gray lobulated growth was seen hanging from the posterior wall of the bladder, and swaying freely upon a pedicle. The mucous membrane in the immediate neighborhood had an injected nodular appearance, extremely suggestive of commencing carcinoma. The color of the hanging body was very puzzling. As there was a difference of opinion among those present as to its nature, I sucked it out with a lithotrite tube and ball. It looked like an old blood-clot. On section it was subsequently found to be necrotic growth and blood-clot. The cystoscope was re-introduced and the diseased site re-examined. There was no bleeding. A patch of stunted processes was seen where the stalk had been attached. As operative interference was contra-indicated by the cystoscope, injections were resorted to, and the hæmaturia subsided.

Three months after this examination the patient visited me, looking hale and hearty, and declaring himself in the best of health. His general condition gave no indication of carcinoma, and I doubted its existence, believing I had been optically deceived as to the nature of the group of nodules on the mucous membrane. I, therefore, re-examined him, and was somewhat astonished to see that the group of isolated nodules had grown into a confluent walnut-sized tumor which was deeply cleft into lobules and of a gelatinous aspect, a growth which I at once recognized as a succulent epithelioma. He very gradually got worse. He suffered little pain, but his emaciation toward the end was extreme.

Death took place two years after the onset of the hæmaturia, and by the kindness of Dr. Travers Stubbs I obtained an autopsy. Not only was the bladder filled with soft whitish growth, but it had attacked the walls, transformed them into carcinoma and had grown outside the bladder so that the entire pelvis was filled with the neoplasm. Both kidneys were in a state of suppurative nephritis.

Hæmaturia of Two Years' Duration; Calculus; Lithotrity.—No Decrease in the Amount of the Hæmaturia. Stalked Carcinoma.[21]—Mr. J., æt. 62, under the care of Dr. Fred Simms, who brought the patient to me in October, 1888, with a diagnosis of vesical growth. The patient was perfectly sound until two years ago, at which date he suddenly had an attack of painless hæmaturia after long exposure and fatigue. The hæmaturia was typical of new-growth; and though a small calculus was discovered and crushed, the loss of blood continued unabated. He suffered when I first saw him from no pain or frequency of micturition; the hemorrhage was persistent, occurring after micturition. On examination with the cystoscope, a whitish-gray walnut-sized growth, evidently stoutly pedicled, was seen hanging from the right postero-lateral wall above the right ureter. There was no cystitis; the patient was advised that the growth could be removed by operation, but that in all probability it would rapidly recur. I saw him nine months after this (July, 1889); he was apparently in perfect

health. He suffered, however, from slight pain at the tip of the penis and in the perineum after passing water, induced most likely by the increased growth of the tumor. He had intermittent attacks of bleeding; no cystitis was as yet present.

In March, 1890, I received the following from his medical attendant: "Mr. J. called upon me early in December and did not appear much worse or much weaker. He reminded me that the year of life given him by myself had passed; he was bleeding pretty steadily. Soon afterward the patient went to stay with some friends in Somersetshire, and there on January 31st he died. His friends and the medical man at Burton wrote to me, and it appears that it was found that the epithelioma had extended through the base and back of the bladder."

Vesical Calculus.

In by far the greater number of cases of vesical calculus (93 per cent.*) the onset bladder symptoms consist of uneasiness in the vesical region, increased desire to urinate, increased frequency of micturition, an unsatisfied feeling after urination, and some smarting or pin-pricking at the under surface of the glans penis toward the finish of the vesical contraction. But this is not invariably so. In about seven per cent. of the cases, these being mostly made up of men about or over fifty with some slight enlargement of the prostate, the first noticeable symptom is blood passed intimately mixed with the urine. Careful cross-examination may elicit the fact that an unusual amount of exercise had been taken a few hours previous to the appearance of the blood; and still more frequently it will be found that an abdominal attack of pain and vomiting has preceded this hæmaturia by a few weeks. This attack of abdominal pain may or may not have been a characteristic colic. More often than not its import has been misunderstood.

The bleeding is usually seen only once, and does not recur until another over-exertion provokes another slight loss. Unless the exertion or jolting has been severe the amount of blood is rarely great. Within a few months of the onset, frequency of urination and slight scalding or pain during the act accompany the appearance of blood. These three symptoms, linked together, will have a direct and constant relation to exercise. It will be noted, however, that the prostate may be a little enlarged and that the urine deposits oxalates or uric acid. The average practitioner, finding the urine acid, clear, and of good specific gravity, will probably be indisposed to diagnose stone,

* The statistics are from my notes of calculous cases and are probably only approximately correct, for a number of cases of calculi in the atonic bladder are included in my lists, and these almost never produce hæmaturia.

and will be tempted to state that the hemorrhage is a relief to the prostate; and it is often only when the stone has produced a mild attack of cystitis that the sound will be used and the cause detected. The reason for the latency is, I believe, a slight upraising of the median lobe and a corresponding depression in which the calculus lodges, probably being trapped there originally on its descent from the kidney.

ILLUSTRATIVE CASES.—H. J., æt. 71. About two years before coming under observation he passed without pain and without any frequency of urination a considerable amount of reddish blood which was intimately mixed with the urine. The blood disappeared with rest. These attacks were intermittent and probably dependent on increased exertion. Latterly he had had pain after micturition which was increased by exercise. The prostate was enlarged, the urine was clear, sp. gr. 1.010, acid, and deposited a cloud of mucus.

A small uric-acid stone weighing 124 grains was removed by litholapaxy.

Rev. H. C. P. aged 71. Two months before coming under observation he passed blood, at first in streaks and then intimately mixed with the urine. He had no frequency of micturition and no pain until a few days back, when he noticed a slight pricking in the penis after the act. He believed the blood had some relation to the amount of gardening he did. The prostate was enlarged, and behind its intra-vesical projection a small pea-sized stone was found and crushed.

C. P. H., aged 60. A year ago he passed coffee-colored urine without pain or frequency. This passed off, but a sense of obstruction which he then experienced at the neck of the bladder was never quite lost. The discoloration of the urine returned occasionally, but it was never bright red until four months before I saw him. He then went a long drive in a drag and bright-red hæmaturia ensued. The color was almost like pure blood and accompanying it was much irritability of the bladder, with straining. A few weeks ago he began to suffer from ordinary symptoms of calculus, and on examination he was found to have an oxalate of lime calculus of small size lodged behind the upraised prostate. The surface of the oxalate was seen to be patched with white phosphate of lime, which had probably been deposited during the slight attacks of cystitis. It was removed by litholapaxy.

Hæmaturia Accompanied by Other Urinary Symptoms.

In by far the larger proportion of cases the hæmaturia is not the only symptom noticed. Others—the outcome of functional disturbances of the diseased organ—usually make their appearance either coincidentally or subsequently to that of the blood. With certain exceptions, to be afterward considered, these additional symptoms render the localization of the source of the hemorrhage easy. Thus, when

pain is experienced in the renal organ* the diagnosis is at once confined to those diseases of the kidney which are liable to evoke hemorrhage; while symptoms of irritability of the bladder and obstruction to the stream of urine point to affections of the lower urinary tract.

Hæmaturia Coexisting with Symptoms of Renal Disturbance.

In dealing with symptomless hæmaturia it was shown that occasionally cases are met with in which blood escapes freely from the renal tissue or the pelvis without any pain or tenderness being experienced by the patient in the corresponding loin. In the majority, however, of renal hemorrhages pain in or about the kidney is also present. It is true that in some cases the pain is referred to the front aspect of the kidney and in others to the back; but in most the patient can so accurately locate the pain as to leave the practitioner in no doubt as to the organ affected. Moreover, if deep pressure be made over the renal region, some alteration in the size of the organ † can usually be made out in favorable subjects. In all cases, more or less marked tenderness on pressure is present.

The diseases most commonly met with belonging to this group are: Renal calculus, tubercle, chronic nephritis, and malignant disease.

They may be bracketed as under:

Hæmaturia preceded or accompanied by pain in the kidney.	*a.* Diurnal frequency of micturition, if present, relieved by rest; pus in later stages. Blood ceases on rest.	Stone in the kidney.
	b. Frequency marked at night; pus and débris passed usually in early stages. Blood unaffected by rest.	Primary tuberculosis of the kidney.
	c. No frequency in earlier stages, and without renal colic.	Cystic disease of the kidney. Malignant disease of the kidney.

There is, in the earlier stages of renal calculus and tubercle, a great similarity in the symptoms evoked by both diseases, so much so that it is often a matter demanding acumen and experience to decide as to which disease is present. In the course of a few months, however, the difficulty disappears, for characteristic symptoms develop.

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* It is always worth the trouble to strip the patient and to be certain of the position where pain in the back is experienced—so many complain of pain in the back which is not actually felt in the renal region, but is accounted for by rheumatic conditions of the lumbar fasciæ, hepatic or colonic or prostatic troubles.

† Pain usually means tension on the capsule, and this again accompanies alterations in size and shape of the kidney.

Calculus of the Kidney.

The hemorrhage from a renal calculus does not possess any marked characteristic beyond the fact that it is affected by sudden movement and severe exercise. That which is evoked by a calculus imbedded in the parenchyma of the gland may have occurred once only in the course of many years, and the circumstance have been forgotten—the chief feature of the case being a fixed renal pain. But the fallacy of basing a diagnosis of cortical or imbedded stone on the one symptom of fixed pain in the kidney region must be avoided. I have known localized renal pain with healthy urine to be due to congestion of the liver (post-mortem case), shrinkage of the kidney (operative case), and colonic ulceration. The bleeding which is produced by a stone in the pelvis or in some deep calyx is the salient feature of the disease and varies in character and amount according to the size and surface of the calculus, its position, the range of its mobility, and the health of the mucous membrane around it.

As a general rule, the bleeding in pelvic calculus is often repeated, dependent on or distinctly increased by exertion. It is rarely profuse, the color is never very bright, and the blood is always intimately mixed with the urine.

Prout,[22] who was an excellent and trustworthy observer, says: "In plethoric and gouty subjects who suffer from uric-acid renal concretions, the blood often appears in the urine under the form of a dark coffee-colored sediment mixed with uric-acid gravel. This subsides after a time, leaving the superjacent urine apparently little colored. This hemorrhage is sometimes produced by very slight causes, as, for instance, by an active cathartic which has been taken to relieve a bilious attack. Occasionally the blood is more abundant. Perhaps on the whole renal concretions of oxalate of lime are more apt to produce hemorrhage than any other variety. Renal concretions composed of the phosphates are sometimes accompanied by bloody urine, but if I were to speak from my own experience I should say much less frequently than some other forms of concretions."

These remarks are, I believe, mainly correct, but nephrolithotomy has taught us how frequently "imbedded" calculi of oxalate of lime exist without giving rise to hæmaturia. As a general rule, the bleeding will be found to occur mostly when the calculi are embraced by mucous membrane and to vary in inverse proportion to the amount of pyelitis. Thus, when pus is passed in the urine in decided quantities, the hemorrhage is of infrequent occurrence and in small amounts. I may even go further, and state that hæmaturia due to

calculus is rarely seen when a pyonephrotic sac has been formed. It occurs in such case in only thirteen per cent.*

The hemorrhage which follows the passage of a small stone along the ureter is transient and its causation obvious. That also which accompanies an attack of renal colic without the passage of a stone is merely due to congestion, and subsides in a day or two.

TYPICAL CASES of renal calculus showing how much depends upon the proximity of the stone to the mucous membrane:

A Case of Renal Stone Imbedded in the Cortex of the Kidney under the Capsule and hence Situated at a Distance from the Mucous Membrane of the Pelvis.—J. A., aged 30 (Dr. Eastwood, of Darlington) perfectly well until seven years ago when he fell on to his back on the ice and ruptured his kidney (query?) and passed blood for fourteen days, but never since. From this date he has had a dull, heavy pain from the back of the kidney to the front. The pain never radiates, it is aggravated by exercise and sometimes "sickens" him. He has no frequency of micturition. The stream is good, it never suddenly stops. He has never passed gravel. Urine normal in appearance; specific gravity 1.030; acid; oxalate of lime crystals. A few pus cells. Diagnosis cortical oxalate calculus. Nephrolithotomy. A dark oxalate of lime calculus the size of a monkey-nut was removed from the convex surface of the kidney by merely cutting through the capsule. Cure.

A Case in which Stones were so Deeply Imbedded in the Thickness of the Kidney Substance as to be Unfeelable through the Unbroken Cortex.—G. B., aged 52 (Dr. Alec Mackenzie, of Romford). Pain in left kidney came on suddenly ten years ago; this was severe, did not radiate. Since then the pain has been constant, but subject to exacerbation. Any error of diet or exercise increased it. *Status præsens*—He can cover the "pain area" with his thumb. He frequently passes blood, generally of a coffee-color, but he has neither frequency of micturition nor pain in the act. Urine 1.022, clear, depositing a few blood and pus cells. He always lies on the affected side. Nephrolithotomy incision—a collection of seven stones found encapsulated in centre of kidney tissue—cured.

Long Pointed Calculus Imbedded in Renal Cortex, but with its Point Projecting into lower Part of renal Pelvis.—T. L., 36 years of age (Mr. John Harris, of Dartmouth). Patient complained of left renal pain, from which he had suffered for twenty years. He could cover its position with the last phalanx of his thumb. It could be elicited also by percussion over the renal region, or by any succussion of the body. It came on with any exertion, even with walking. The patient had never had colic nor any radiating pain beyond a left testicular pain if the renal suffering was acute. Sometimes he suffered from great frequency of micturition in the day, and occasionally had to rise five

* It will be found that tumors of the kidney containing calculous material with pus (calculous pyelonephritis) occur usually in women (in the proportion of 5 to 1), and the salient symptoms are pain and constitutional disturbance rather than hæmaturia. (*Vide* Pyuria.)

or six times at night, passing very little at a time. He had never noticed blood in his urine. Has often passed gravel. The urine was clear; specific gravity, 1.020; it contained no pus or blood, and only a few oxalate crystals were visible under the microscope; it contained a slight amount of albumin. By nephrolithotomy I removed a rough-pointed stone, which measured 1¼ inches in length and weighed 1½ drachms. It was imbedded in the lower end of the kidney and its nose projected out free into the pelvis.

Loose Stone in Pelvis Producing backward Pressure Symptoms and Inflammation and Evoking Typical Attacks of Renal Colic.—W., aged 52 (a patient of the late Sir Andrew Clark). Patient had suffered from violent recurrent right renal colic for five years. At first the attacks recurred only once in six months, but the interval of rest diminished, until finally, when he consented to an operation, they were taking place every week.

Each attack was accompanied by numbness in the back, down the inside of both thighs, and in the calves of the legs and testicles. He had passed blood several times, but always of a mahogany color. The patient had faithfully followed careful instructions as to diet, and had taken courses of piperazine without any effect. Before the operation the urine was acid, and contained one-sixth albumin; specific gravity, 1.010; the quantity was ample. He had never had frequency of micturition. On nephrolithotomy a small, flat, oval uric-acid stone was found free in the pelvis and removed. The pelvis was much dilated; but as there was a fair amount of cortex left, the kidney was drained. It healed sluggishly, and left an obstinate sinus, which remained for months.

Cases in which the inflammation has so far advanced as to produce extreme pyelitis are quoted in the article on pyuria.

Primary Chronic Tuberculosis of the Kidney.

It will be noted that *primary* chronic tuberculosis only is dealt with in this group, the reason being that ascending tuberculosis invading the kidney secondarily from a source in the testicle, prostate, or vesiculæ seminales is apparent and diagnosable by touch. Invasion from these sources induces pain and distress in the bladder in the larger number of cases prior to implication of the kidney. The attention of the practitioner, therefore, is directed to the bladder, and this particular region is considered later on. Occasionally the invasion of the kidney from the testicle is by the roundabout route of the lymph paths which lie alongside the venous channels of the testis, ascending to their termination in the left renal vein and inferior vena cava; these not only mix with the ureteral vessels but also not infrequently receive trunklets which drain the perirenal fat and the capsule of the kidney.

Miliary tubercles irrupt from beneath the mucous membrane of

the renal pelvis, or colonize in the glomerular zone of the cortex. As our knowledge increases, we may be able perhaps to group separately the symptoms evoked by the deposit in each of these differently constructed areas. At present this cannot be done with accuracy, and I can only express my belief that, in the pelvic form of the disease, the initial symptoms are as follows: Blood and pus appear in small amounts in the urine, either coincidently with renal pain or very soon after it commences; the stages of the disease are passed through more quickly, and the bladder—our index to the progress and the severity of urinary tuberculosis—is affected earlier. When the deposit is, however, situated in the cortex, it has to break into the renal pelvis before it can give rise to characteristic symptoms. Polyuria, from the irritation of its presence, is perhaps the symptom first noticed or complained of, even before the aching in the kidney. The urine is murky, of low specific gravity, and contains albumin over and above that due to the trace of pus. The hemorrhage from these two positions also varies, hence perhaps the divergence in the opinions of writers on the subject. In the early stage of pelvic ulceration the bleeding is usually slight and intermittent; when, however, a cortical deposit sloughs out suddenly into the pelvis, there may be profuse and dark but transient hæmaturia.

But I would again remark that the hæmaturia in primary chronic tuberculosis of the kidney is, I believe, only a feature of the early stages; it passes away more or less rapidly, and gives place to the passage of pus and clumps of caseous débris, and, when the bladder is fully attacked, to vesical bleeding.

Difficult as is the proper allotment of the symptoms induced by tuberculosis of the kidney and the bladder to their respective organs when both are implicated, I am probably right in assuming that hemorrhage from the tubercular bladder is much more abundant and much more easily evoked by cold than is that from the kidney.

Tubercular Deposit on the Mucous Membrane of the Renal Pelvis.—Mr. Knowsley Thornton[23] records the following case: "All the symptoms were those of calculus—pain over the kidney and down the ureter, with attacks of colic—then hemorrhage, and finally profuse suppuration and enlargement of the kidney. When I opened the pelvis I found its lining membrane covered with little seed-like tubercles and there was no stone. The patient was immediately relieved of all her symptoms, but the fistula persisted, and the other kidney becoming affected, she died of uræmia seven months after the operation. The post-mortem revealed extensive tuberculosis of the kidney operated upon and of the rest of the urinary organs—the other kidney having evidently been more recently attacked, and probably by extension up the ureter. In neither kidney

was there ulceration or caseous deposit. The patient was, at the time I operated upon her, a stout, rosy woman, so much so that I should have doubted her statements as to the pains she suffered had I not seen her actually in great agony."

Chronic Tuberculosis Commencing Probably in the Cortex of the Kidney and Invading Bladder, Prostate, and Testicle Secondarily.—D. J., 33 years of age (under Dr. Hilliard.) Up to four and a half years previous to seeing me this patient was in perfect health. He had, at that time, an attack of pain in the right side, which was called by his doctor renal colic. The character was as follows: Blood appeared in the urine from two to seven days before the onset of the attack; it came in clots, and often the bloody urine was very red with much bright blood. The hæmaturia ceased, and the pain then seized him across the back, and coursed down the right ureter into the right testicle. He vomited, rolled about the bed in the acuteness of the agony, and passed water very frequently, the character of the secretion being normal to the eye. These symptoms lasted for twenty-four hours. He never passed a calculus.

These attacks of renal colic continued to recur at intervals of two or three months, becoming latterly more frequent and more severe until eight months before he saw me, when suddenly all symptoms ceased in the kidney. He had neither kidney-ache nor severe hæmaturia, but the bladder became troublesome.

Five months after the cessation of the renal pain, he had to get up at night to pass water, and he was forced to empty his bladder more often than usual in the day. The vesical irritability increased, pain at the end of the penis after micturition set in, and in this state and with this history he came under my care, requesting to have the stone which he had been told was in the bladder removed as soon as possible.

His symptoms were as follows:

"He passes water, about a teacupful at a time, every half-hour, day and night; has much glans pain after micturition. If blood is seen, it is intimately mixed. There are no testicular deposits; no prostatic deposit, but the right side of the bladder base feels shotty. No renal tumor, but there is a tenderness over the right kidney. Urine contains pus; tubercle bacilli have been found; specific gravity is 1.010."

Electric Cystoscopy.—"Bladder only holds three ounces. There is no stone. The mucous membrane of the base is turgid, dark-red, and spongy, like that of an exposed rectum. The rest of the bladder is either coated over with adherent patches of dull whitish pus, situated on an inflamed, purple, succulent mucous membrane, or is ulcerated. These white patches seem to be the boundaries of large superficial erosions of the surface. They have a fleecy base, and evidently rest on the submucous tissue. The ureteral orifices are puffy, more especially the right. There is much pain on instrumentation. Even when deeply under chloroform he flinches and moans on any slight over-distention, *i.e.*, anything over three ounces." The diagnosis of descending tuberculosis was made, and Dr. Hilliard was warned of the probable implication of the right testis and right lobe of the prostate, which took place three months after this exam-

ination. Since then I have had this patient under close observation for eighteen months; the left epididymis is now affected. Several collections of pus (chronic abscesses) have formed under the skin of the forearm and thigh. The testicular deposit on the right side came to the scrotal surface and was opened, as were the other abscesses, and scraped, iodoform being packed into the suppurating cavities. He now passes water every half-hour in the day and every three-quarters of an hour at night; his legs are œdematous, his sufferings great, and I doubt if he will live much longer. It is now six years since the onset of the symptoms.

Differential Diagnosis between Stone and Tubercle of the Kidney.—Our capacity for differential diagnosis here, as in other and similar problems in urinary surgery, will depend much upon our skill in cross-examining as to the onset and initial symptoms, and upon our due appreciation of the nature and intensity of the irritation which has produced them. We recognize that in stone we are dealing with a foreign body confined more or less loosely in a sensitive space, and dependent, therefore, for its power of inflicting injury (as evidenced by the blood and pus in the urine) upon the exercise which the patient takes. On the other hand, in tubercle we realize that we are grappling with one or more foci of short-lived tendencies, and, therefore, of powers of producing puriform urine; that these foci are of caustic and continuous irritative properties, which place them beyond the calmative control of posture or of bodily rest. I believe that the best indications for the diagnosis of renal tubercle are to be found in the family history of the patient; in the appearance of pus in the urine very soon after if not coincidently with the renal pain; in the powerlessness of absolute rest to affect or subdue the symptoms, and in the causeless elevation of temperature.

Other differences, however, exist, and an attempt may be made to tabulate them thus:

Primary Renal Tubercle in Early Stage.	*Renal Stone in Early Stage.*
Family history of phthisis or cancer.	Family history negative, or of gout or gravel.
Personal history: Perhaps tuberculous bone-, joint-, or gland-disease; very rarely any previous urinary symptoms.	Personal history: Negative, except perhaps the passage of sand or gravel; of a "weak" loin; of testicular neuralgia or "sciatica."
Symptoms, onset: Polyuria of a murky type (the frequency of micturition being due to the quantity passed, not to irritation), vague lumbar pain or a sudden chill, and severe pain in one kidney, but rarely colic. Then frequency of micturition in the early stages at night from irritation of acrid urine.	Symptoms, onset: Vague lumbar aching or a sudden colic. If frequency of micturition exist it is due to irritation; small quantities are passed often during the day, but not at night. This is relieved by rest.

Primary Renal Tubercle in Early Stage.	*Renal Stone in Early Stage.*
Colics appear later, are usually less severe, are more easily under the control of drugs, do not usually retract the testicle, and are preceded by rose-red blood if they are induced by ulceration and not by blockage.	Colics: More or less severe according to composition and size of stone, and its position. They may be followed by bleeding.
Hæmaturia: Slight in amount, spontaneous in appearance, uninfluenced by rest.	Hæmaturia: Intimately mixed; much more marked than in tubercle dependent on exercise.
Fever: Temperature may be slightly raised at night.	Fever: None.
Urine: Cloudy at the outset from admixture of mucus and pus, acid, of low specific gravity, light-colored, depositing a thin layer of pus with streaks of blood, débris of connective tissue and small clumps of caseous material. Albumin appears early.	Urine: Clear at outset, containing evidences of calculous tendencies in the shape of crystals, acid, of normal specific gravity. Pus appears later in course of case, and then only forming a deposit when pyelitis has been induced.
Tubercle bacillus found, but with difficulty and after much search in acid urine.	Negative.
Inoculation of urine deposit into animals induces tuberculosis.	Negative
General condition: Patient ailing, "never feels well," is anæmic, easily tired, but has no loss of appetite.	General condition: Patient may enjoy excellent health between colics or in intervals of rest.

Cystic Renal Disease.

It has been remarked in discussing the symptomless hæmaturias that some cases of chronic renal disease bleed smartly and painlessly. There is no doubt, however, that occasionally hemorrhage from this source is accompanied by pain; and in some of these I have found definite cystic conditions.

CASE.—I was called to see a man, aged 31, by a physician who desired me to perform some operation for his relief. The patient was blanched by profuse hæmaturia; had scar evidences of having suffered from severe secondary syphilis; his urine was loaded with casts and albumin, and showed a specific gravity of 1.009. Both kidneys were tender on deep pressure. He had had severe malaria and syphilis fourteen years previously. A year ago he had had a sharp attack of hæmaturia accompanied by pain in the right side. On July 1st, 1894, he was suddenly seized with great pain in the region of both kidneys, and in twenty-four hours bright blood appeared in the urine and became intermittent. The amount of blood varied from a mere trace to an almost pure condition. He urinated ten times in twenty-four hours and passed 60 to 107 ounces daily.

On July 5th, the urine being then clear, the physician introduced a Pravaz syringe into the left kidney and a syringeful of pure blood was withdrawn. About fifteen minutes afterward the patient passed fourteen ounces of blood per urethram, accompanied by severe pain in the left side. The hæmaturia continued, diarrhœa appeared, and a rigor took place a week after the exploration. I declined to interfere by operation, and the patient died on the tenth day after. On post-mortem both the kidneys were found to be enormous and transformed into a conglomerate mass of multilocular cysts, probably of congenital origin.

Malignant Disease of the Kidney.

I have already expressed my belief that the onset symptom in the majority of cases of malignant disease of the kidney is hæmaturia, also that renal pain is not at first experienced. The consideration of this disease, therefore, fell into the group of symptomless hæmaturias. But I am not supported in this statement by the literature of the subject, which represents the pain as being of quite a marked character at the outset,* and, moreover, I am aware of several cases in which pain either preceded the hemorrhage when the growth was very rapid, or a calculus pre-existed. In two cases the pain was obviously induced by the practitioner lighting up acute suppurative nephritis by his examination. It is, therefore, necessary briefly to allude to maligant disease of the kidneys under this group also.

Case.—*Malignant Disease of Kidney with Pain in affected Loin, due probably to Tension on the Capsule of the Organ.*"—M. X., æt. 50, consulted M. Reliquet in December, 1884, for urinary trouble. His history was as follows. For many years he had suffered from nephritic colic accompanied by hæmaturia, and voided uric-acid gravel. After passing in 1881 a larger piece of calculus than usual, he remained well until October, 1884, when he again had an attack of nephritic colic. Toward the 20th of October of this year, fever, rigors, headache, anorexia, and frequent micturition appeared. The urine had a strong odor, was muco-purulent, but abundant. No renal tumor could be felt at this time on the left side, where pain was complained of, but in the early part of December a tumor the size of a large apple was discovered in this region. It was painful on pressure, slightly movable, and was considered to be a hydronephrosis by the medical attendant.

The patient now consulted M. Reliquet, who found a left renal tumor the size of an infant's head, without bosses or soft points. The urine was scanty, murky with purulent deposit, ammoniacal, and very fetid. There was extreme irritability of the bladder, a few

* I cannot help thinking that insufficient attention has been paid to the onset symptoms. It is true that clot colic is pain, but then the cause of this is obvious and the patient does not suffer until another clot is plugging the ureter or urethra.

drops of urine only could be voided at a time, with much suffering experienced both before and after the act. The patient demanded to be released from the excessive and recurrent pain of nephritic colic and strangury.

M. Reliquet, believing that he would not live much longer in such extreme suffering, performed lumbar nephrotomy by means of the thermo-cautery. When the renal tumor was laid bare, it was punctured with the thermo-cautery, and on withdrawing the point a jet of blood shot out from the opening with such great force that it passed over the operator's shoulder. The finger was inserted into the kidney, and it was then found that the tumor was extremely soft and friable, so much so that when an attempt was made to enucleate the kidney it broke down under the fingers in all directions. The operator, after tearing away as much as possible of the renal mass, arrested the profuse hemorrhage by means of sponges packed into the wound.

The patient was immediately relieved of all pain in urinating, the vesical irritability subsided, the nephritic colic ceased, and the urine augmented in quantity. Neither nausea nor vomiting reappeared, the patient was able to take food with great comfort, and indeed pronounced himself "cured." In spite, however, of this remarkable result of the operation, the growth progressed, and the patient died two months afterward.

CASE.—*Acute Malignant Growth of Kidney.—Clot Retention, Catheterism and Washing.—Acute Suppurative Nephritis.—Great Renal Pain.*—J. S., æt. 60. Two months before death the patient thought he had caught cold in his kidneys because he suddenly passed bright blood. He was placed upon iron and ergot, but no improvement followed, and he began to pass many worm-like clots. There was no renal colic, nor tenderness on deep pressure in either renal region. The prostate was enlarged antero-posteriorly and laterally. Under the use of hazeline and with the enforcement of rest the blood began to diminish, and in a week's time it had ceased. The patient then began to suffer from pain in the left loin, and was unable to make water. A No. 12 English silver catheter was passed, and thirty ounces of dark-colored urine and clots were evacuated. Retention continued and almost pure blood was passed. The bladder was washed out with hazeline and a solution of boracic acid. The pain in the kidney now became very severe, the retention ceased, the temperature began to rise, then to oscillate, and the patient died three weeks after the vesical treatment was commenced. On post-mortem examination a large kidney with scattered deposits of soft carcinoma was found, the unimplicated renal tissue being in a state of acute nephritis. The fellow gland was also affected with inflammation.

I believe that in this case urethral fever or slight cystitis (following on clot retention, and the passage of a catheter and the manipulation necessary to evacuate the clots) induced the pain and the fatal result; for fever appeared directly upon the interference and the patient's condition changed at once and for the worse.

Hæmaturia Coexisting with Symptoms Denoting Disease in the Lower Urinary Organs.

The class in which symptoms such as frequency of micturition, obstruction to the stream, and pain in the urethra, suprapubic region, or perineum, precede the appearance of blood in the urine, comprises most of the diseases of the bladder and urethra. The diagnosis is, however, in the majority of instances, comparatively easy. Every method of examination, the urethral bougie, the calculus sound, the catheter, must be resorted to for the differential diagnosis.

These diseases may be bracketed as under, but only those calling for special mention need be alluded to.

Hæmaturia preceded by vesical irritability. Pain in the urethra, especially at the glans on urination.	*a*. Childhood to young adult life.	Vesical irritability; pain and blood, subsiding on rest.	1. Stone in the bladder.
		Frequency of micturition diurnal. Obstruction to stream slight.	2. Prostatic troubles due to gonorrhœa or onanism. Benign growth at vesical orifice.
		Frequency nocturnal as well as diurnal, unaffected by rest except in the earliest stages.	3. Catarrhal or primary tubercular ulceration of bladder. Tubercle of prostate.
Pain in other localities, indicating a vesical or prostatic origin and obstruction to the stream.	*b*. Adult life up to fifty.*	Evidence by bougie.	4. Stricture and cystitis. Hemorrhagic cystitis.
		Evidence by sound.	5. Calculus; calculous cystitis.
		Evidence per rectum.	6. Infiltrating carcinoma away from orifice. Prostatic carcinoma.
	c. Old age.	Evidence per rectum and by sound, etc.	7. Stone in the bladder. 8. Prostatic enlargement.

Stone in the Bladder.

The symptoms of stone in the bladder need not be discussed in detail. In the child and young adult they are especially marked, because there is, at these ages, no prostatic enlargement which can prevent the calculus from falling upon the sensitive neck of the bladder and from eliciting those symptoms which we recognize as characteristic of the disease. In the less sensitive bladder of the aged the

* This subdivision into groups marked by the ages of the patients is neither scientific nor accurate. It is convenient only, for it serves to remind one that the age of the patient is often a useful guide to the character of the complaint. Thus stone, though occurring at every age, is most common before puberty and after 55 (Sir H. Thompson). Stricture generally arises before 35; inflammatory prostatic disease between 20 and 30; benign growth of the bladder between 20 and 40; malignant growth of the bladder is most common before 10 and after 45; senile prostatic enlargement about 48 and onward.

stone may be lodged behind the upraised prostate, and thus be "latent" or symptomless, except for the cystitis it produces. In some of these cases, as I remarked when considering the symptomless hæmaturia, blood after exercise is the only symptom noticed, but the urine is soon found to contain traces of pus or mucus.

The hemorrhage of calculus in ninety-three per cent. of my cases was preceded by that feeling of irritation which a foreign body excites in a cavity sheathed by sensitive mucous membrane and surrounded by muscle, viz., by involuntary spasmodic contractions, and by a constant desire to urinate. These symptoms are soon followed by pain at the end of the penis on micturition, and a teasing sensation that the bladder has not been thoroughly emptied. Attacks of cystitis supervene and blood appears. It is to be noted, however, that when *the catheter is habitually used* and the prostate is upraised, the symptom which is characteristic of stone is not blood but pain on movement. This is a fitting opportunity to remind the reader that cases are met with in which persistent hemorrhage is complained of as following a skilful litholapaxy. The spongy mucous membrane still bleeds, and the patient has suspicions that some fragments have been left behind by the operator. This does undoubtedly happen, but there are bladders which still ooze although all grit has been removed. In some of these cases it will be found that phosphate of lime adheres to the inflamed surface in patches, and that when these deposits scale off the bleeding and irritation cease.

I have seen two patients lately, in whom a calculus had been crushed by one of the best European lithotritists, but in whom the hemorrhage continued. On returning to their surgeon they were told that they were suffering from a growth in the bladder. I was subsequently asked to examine with the cystoscope, in order to confirm or rebut the diagnosis. In each case I saw merely an intensely congested spongy mucous membrane, and by administering a little port wine to the patients and sending them to the seaside, the hemorrhage vanished.

CASE.—*Calculus, Chronic Cystitis, Lithotrity, Hæmaturia.*—M., æt. 59, consulted me for hæmaturia. His history was as follows: In March, 1885, lithotrity was performed for a small angular phosphatic calculus. The amount of blood which then appeared in the urine depended upon the amount of exercise taken. Since this operation he has suffered more or less from catarrh of the bladder, which increased greatly in December, 1888. The patient has always had very irritable mucous membranes, his throat and stomach frequently becoming inflamed upon any sudden increase of mental work or worry. In January, 1889, he commenced to pass blood, and continued to do so without intermission for five months. The urine

was of a dark-brown color, the blood being uniformly mixed, the amount of blood being greater at night. He suffered no pain, and only occasional irritability. On examination I found that the prostate was not enlarged, that no residual urine was present, that the stream was full and forcible, never intermitting. On cystoscopy no tumor nor growth was visible; the mucous membrane was swollen and gelatinous in every part, and of a dark, dull purple color. Evidently the blood was oozing from many points. The injection of warm water irritated the bladder greatly, and he passed an increased quantity of blood for a few hours after the examination. This excess, however, rapidly subsided. He was eventually cured by change of air.

Benign Vesical Growths Situated so as to Obstruct the Urethral Orifice of the Bladder.

Villous papillomatous growths of the bladder, which either fall upon the urethral orifice or grow around that outlet, differ from other benign growths of the bladder by provoking symptoms of vesical irritability and obstruction to the stream, before the hemorrhage. Such tumors number eight per cent. of all villous papillomata and have peculiar dangers attached to them.

Typical Case.—*A long-pedicled, Villous Papilloma Obstructing Urethral Orifice of Bladder.*—Mr. A. S., aged 24 (under Dr. Keser). He was blanched and breathless from loss of blood. He gave me the following account of his case: A year ago he was suddenly seized with a desire to pass water frequently. There was slight difficulty in doing so, but no pain. Blood appeared about a week later, and all symptoms subsided. In fourteen days' time he had a precisely similar attack and since then he has suffered for an entire year from irritability of the bladder and hæmaturia. He has been unable to hold his water for more than two hours unless in bed, from which he rises twice in the night. The first part of the stream is dark blood, the middle is clearer, and the last portion bright blood. The stream is slow, powerless, and thin. It shoots out at the commencement with some little force; then it stops abruptly, especially if he has retained water longer than usual. He has a slight aching in the right loin. Electric cystoscopy revealed a large papilloma, attached by a pedicle to the rim of the right ureteral orifice. Suprapubic cystotomy was immediately performed and the pedicle dissected out of its muscle bed, which latter was sound. Recovery followed.

The particular danger to which these corking growths expose the patient is septic pyelonephrosis arising from the examination. I have always found much residual urine, as well as evidence that backward renal pressure has been exerted on one or both kidneys in these cases. The cystoscopic examination entails washing, and if an operation is not immediately performed and the bladder drained,

cystitis from introduction of organisms to the residual pool may take place and pyelitic and nephritic complication ensue.

Tubercular Ulceration of the Bladder.

The symptoms of primary tuberculosis of the bladder are very characteristic. They are nearly always thought at first to be due to stone, though the differences are marked. A young male,* sixteen to twenty-five years of age, often without any venereal history but with a family tendency (usually maternal) to tubercle, suddenly experiences a pain in the glans or mid-penis while urinating. There is an almost immediate increased frequency of micturition in the day. In 76 per cent. of my cases, frequency of micturition and penile pain were the first symptoms noticed, but in the smaller number, in which I suspect a vesical deposit secondary to some extra-urinary tubercular focus sloughed out, hemorrhage was the onset symptom. Soon the night is much disturbed by constant calls to empty the bladder. These symptoms are followed in a variable time according to the acuteness of the disease, from a few days to a few months, by the appearance of blood in the urine. The blood is often profuse and very bright at one time or other in the course of the early stage, from sloughing out of the deposits; but these attacks are for the most part transitory, and the patient usually only sees a few drops of blood follow the end of the stream of urine, strained out as it were by his efforts to get rid of "something." The stream of urine is often arrested, but if the cause for this is inquired into carefully, it will be ascertained that the patient checks it *voluntarily* on account of the spasm and pain. The sudden cessation, therefore, is not due to the abrupt plugging of the urethral orifice with a stone. After a few months the bladder becomes contracted, so that it cannot contain more than 6 to 8 ounces, and if the surgeon forces in more by means of a syringe, "the distention reflex" is so great that the patient will often kick or groan even when all corneal sensation has been abolished by ether. The urine from the very first contains traces of pus, and this increases rapidly to a thin but distinctly visible deposit. The secretion is more or less murky, of a light color, of normal specific gravity, and it remains feebly acid or neutral until the surgeon makes it alkaline by interference. At first there are well-marked periods of quiescence, often for a fortnight or more at a time, and in these periods the irritability, pain, and blood disappear, or nearly so. It will be noted how readily the bleeding is re-started—a few

* A young male is taken as a type, but the young girl, though not equally liable to the disease, presents a similar train of symptoms.

hours after an extra exertion, or a sudden chill to the body, as in bathing or getting wet, a sharp attack of hemorrhage takes place, clots and bright blood being freely passed. To a superficial observer the early symptoms of primary vesical tuberculosis are very like those of stone in the bladder. The same irritability, the same glans pain after urination; the blood, pus, and murky urine; the stoppages in the stream, and the periods of quiescence appear in both diseases. There are, however, points of difference in the patient, in his symptoms, and in his urine, which will at once lead to the existence of stone being doubted. His youth, his family history; the distressing irritability of the bladder at night; the sudden and causeless appearance of bright hæmaturia not increased by exercise nor checked by rest; the sudden relief of the suprapubic pain and the rapid disappearance of the glans pain after the evacuation of the bladder; the persistent post-scrotal pain; the very light, acid, murky, scentless, puriform urine which is passed at the very outset of the trouble; and finally, the fact that the periods of quiescence are uninfluenced by violent exercise, point to the tuberculous and not to a calculous nature of the disease.

The progress of the case, however, will probably dispel any doubt, for the epididymis will become implicated, and the prostate will then be felt, *per rectum*, knobby or shotty from the deposition of tubercle; or the kidney will become painful and swollen and the temperature will rise at night. If an incision is made into the kidney, a quantity of inodorous caseous pus will be evacuated, to the great relief of the patient and the amelioration of the bladder symptoms.

Stricture.

It but rarely happens that bleeding occurs in stricture of the urethra apart from instrumentation.

The hæmaturia which sometimes appears spontaneously in stricture is usually from the neck of the bladder, and is strained out by the patient from the congested mucous membrane lining that orifice. The vessels, especially the veins, of the neck of the bladder are frequently seen by means of the cystoscope to be large and tortuous in tight stricture, and in those cases in which spontaneous hemorrhage has occurred, large and distinct extravasations are seen in the lower part of the posterior wall. There is no doubt, however, that the hemorrhage may proceed from granular kidney which in rare instances coexists with stricture. In all cases of spontaneous hemorrhage in stricture there must have been very decided narrowing and marked obstruction to the stream.

The Hæmaturia of the Senile Enlarged Prostate.

The sponge-like tissue of the enlarged prostate is often very erectile and is, therefore, singularly capable of sudden and rapid enlargement from congestion. Its capacity for bleeding is enormous.

Surgeons who have removed enlarged median lobes are often struck with the disparity in size between the lobe felt and seen *in situ* through the suprapubic opening and the lobe shortly after it has been removed. This diminution in size is due to drainage. The rapid erection of the prostate causes excessive stretching of the superjacent mucous membrane, pegged down as this is posteriorly by the unyielding trigone and anteriorly by the dense orificial attachment, and the veins of this layer become thinned and dilated; finally an ulceration opens into their channels. It used to be the custom to ascribe all spontaneous bleeding from enlarged prostate to the bursting of varices or piles of the bladder. This I am sure is a mistake. It is true that certain large and tortuous veins are often seen with the cystoscope coursing beneath the mucous membrane covering the intravesical enlargement of the prostate, but it is doubtful if definite congeries of tortuous veins meriting the name of varices or piles often exist. The only instances I have been able to find in European museums are in Upsala, Sweden (Nos. 1229, 1388). They are injected with blue, which shows their character well.

Slight spontaneous hemorrhage from a senile enlarged prostate which does not obstruct so greatly as to necessitate catheterism is not uncommon. Any slight mechanical cause may suffice to reproduce it when once it has occurred. Jolting in a conveyance, venereal indulgence, or a slight chill may produce a hemorrhage without retention. The bleeding is supposed to be a relief to the prostate, and it may be so. I believe in some instances at least that this symptom is a local expression of a general arterial change, for some patients who have suffered thus have subsequently died of apoplexy. This observation, however, needs the correction of wider experience.

Prostatic blood may escape pure in the intervals between urination and stain the shirt or bedclothes, leading the medical man to believe that it originated in the anterior urethra. It may appear either at the commencement or at the end of the stream, or it may pass into the bladder and find exit with the contents of that viscus. I have known the urine black for days from this source.

CASE.—*Enlarged Median Lobe of the Prostate—Sudden Attacks of Profuse Hemorrhage with Massive Clots.*—B., aged 70, consulted me in August, 1894. His history was as follows: In 1886 he was seized with retention from holding his urine too long. A silver catheter

was used, and he bled freely. For several years after this he used a soft rubber catheter once daily. Several times in the summers of 1887, 1888, and 1889 he had profuse hemorrhages from the bladder. They occurred without warning and were accompanied by massive clots which had to be removed by suction through a large-eyed silver catheter. Toward the end of 1892, cystitis appeared. He had been repeatedly examined with the sound but no stone had been discovered. He was, however, not satisfied, and in July, 1893, ran down a steep hill, leaping high as possible all the while to ascertain if he could feel a stone. He suffered no pain from this unusual exercise at the time, but intense pain came on next day, and being at Würzburg he was sounded by Professor Schönborn and a large calculus was detected. It was completely removed by litholapaxy in three hours. It was then supposed that the cause of the hemorrhage had been discovered and removed, but the attacks did not cease and the profuseness of the loss was not at all diminished. They still occurred every few months. I examined with the cystoscope and found a small upraised median lobe; no stone existed, the bladder was capacious. There was not the slightest difficulty in introducing the shortest cystoscope. A month after this I was suddenly summoned to see him. The bladder was distended with blood clot, and it was with much difficulty that I passed a very long and largely curved prostatic catheter and evacuated by suction and washing some eighteen ounces of black clot. The prostate was swollen to a remarkable size and the median lobe, which previously had been inconsiderable, was now most prominent. The patient now mentioned that he had suffered for years from piles which bled profusely, the blood running down his trousers on to the floor, and that when they bled freely the bladder was better. He recovered completely from the attack. Adding to this other and similar cases in which I have seen the blood issue from the surface of the median lobe, I have but little doubt that the origin of the hemorrhage was prostatic.

Cases in which Renal Pain Coexists with Vesical Disease, and Vesical Pain is Experienced in Renal Disease.

Without placing too much stress upon cases in which pain is experienced at some point of the urinary tract distant from the actual site of the hemorrhage, it is wise to remind the reader that *renal* pain is not infrequently felt in ascending tuberculosis, although the bladder is the actual source of the bleeding. Other cases are also, though rarely, met with in which compression of the lower urethral orifice by vesical growth or by impacted calculus leads to backward pressure on the pelvis of the corresponding kidney, and consequent tension pain is felt in the loin. Conversely, though still more rarely, cases will be encountered in which the kidney is the seat of a stone which is exciting hemorrhage, but the pain is experienced not so much in the kidney as in the bladder and urethra. It is much more common to meet with sympathetic vesico-urethral pain in pyuria

of renal origin, and notice will be taken of this subject under the heading of pus in the urine.

Treatment of Hæmaturia.

Before considering the treatment for the various forms of spontaneous hæmaturia, it would be as well to consider whether there is any which had better be left unchecked. I believe that in hard carcinomata of the bladder, in engorged senile enlargement of the prostate, and in renal hæmaturia the result of cardiac disease, the bleeding is, to a certain extent, beneficial. In hard carcinoma there is often a great increase of pain when the bleeding is arrested and a sensible diminution in the suffering when it has become re-established. The treatment of these cases is hopeless, and it is better and kinder policy to allow the patient's life to ebb away than to prolong his misery by conserving his blood capital. In those congested senile prostates, which bleed periodically, I suspect that there is a tendency to atheromatous degeneration of the vessels, and the bleeding acts not only as a safety-valve, but serves to deplete an over-tense tissue. In renal hemorrhage from obstructive mitral disease or granular kidney, the high blood pressure is often greatly relieved by a slight intermittent hæmaturia.

In these three diseases, then, I would suggest that the practitioner do not hastily check a hemorrhage which may be affording his patient relief.

Although the successful and scientific treatment of spontaneous hæmaturia depends, of course, upon ascertaining and removing, if possible, the cause of the hemorrhage, yet occasionally the practitioner is not able to do more, in sudden and urgent cases, than to combat the immediate effects of the loss of blood.

The first and most essential step is to allay the patient's fears and to restore confidence. To many the appearance of blood issuing from so unusual a channel as the urethra is most alarming. From my own experience, I am sure that in the large majority of cases a promise may be made that the hemorrhage, if it is the first or among the first attacks, will subside with proper precautions in two or three days. When the hæmaturia has once become established, it is otherwise.

Position.—Absolute rest in bed is of primary importance; many severe hæmaturias can be readily controlled in their early stages by the recumbent position. It must be rigidly enforced in proportion to the severity of the attack. High elevation of the pelvis is of real value in certain cases of vesico-prostatic bleeding.

Application of Cold.—The external application of cold is of value,

perhaps more to quiet the apprehensions of the patient than for much good it will do in the hæmaturias of the lower urinary tract. It is certainly of great value in ruptured kidney, for here it not only assists in checking the bleeding, but also mitigates the traumatic peritonitis* which sometimes ensues even when the peritoneum has been untorn and the viscera uninjured. Cold may be very efficiently applied by means of ice-bags over the loin or over the bladder; but a cleaner and easier method is by Leiter's pliable coils, which may be moulded to any part, and through which a continuous current of cold water can be conveyed. I place a certain amount of reliance upon ice in the rectum for checking hemorrhage from the bladder and especially from the prostate. I believe it causes contraction of the muscle planes of the wall of the bladder as well as those of the blood-vessels. It is a good plan to throw each piece of ice into warm water to smooth off the sharp edges of the fragment before pushing it into the rectum.

Drugs.—I cannot speak very highly of any styptic by the mouth. In sharp arterial bleeding, ergot is perhaps the most reliable. It is given in doses of half a drachm to a drachm mixed with some preparation of opium, every two, three, or four hours, according to the severity of the case. If the hemorrhage be moderate and dark, fluid extract of witch hazel, in drachm doses, is of value. Iron preparations, such as the iron aluminate, or tannate of alumina or acetate of lead are worth a trial in moderate vesical hemorrhage. In the profuse vesical hemorrhage in *atonic* bladders, ergot and nux vomica combined with gallic acid is perhaps the best remedy to administer. In some cases, an acidulated drink, or the acid infusion of roses, answers well.

But in every hæmaturia some sedative ought to be incorporated with the drug selected. I usually employ opium freely, except when there is reason to suspect serious renal change or where opium is contra-indicated, and then I substitute bromide of potassium, hyoscyamus or cannabis indica. Belladonna is best avoided, for it tends to weaken that contractile power of the bladder which is of real therapeutic value.

Oil of turpentine is a favorite with many. It has the disadvantage of irritating the neck of the bladder in some patients; the dose is five to ten minims cautiously increased, given either in capsules or in mistura amygdalæ.

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* In many cases of sudden and profuse loss of blood, whether from the kidney, bladder, or prostate, the shock and exhaustion will be marked by distention of the gut, consequent tympanites, and general but not severe abdominal pain. It is a mistake to consider these as signs of peritonitis.

Far below these in value, but warmly recommended by various writers as having especial power to arrest hæmaturia, are a number of drugs such as matico, cinnamon, liquorice, lemon juice.

Professor Guyon places very little reliance on styptics by the mouth. He aims at improving the general constitutional tone.

An attempt may be made, suggested by Professor Wright's work upon the coagulation of the blood, to increase the coagulability of the blood by administering chloride of calcium. I believe, however, that care must be exercised with this and other strong styptic drugs in profuse hæmaturia, for the tendency with such remedies is to increase the size of the clots, and this is especially the case with chloride of calcium. In many of the diseases giving rise to hemorrhage after the age of fifty there is perceptible diminution of the expulsive power of the bladder, and clot dysuria and retention and all their accompanying septic evils may easily be produced.

Diet.—Solid food had better be avoided until the severity of the attack has abated. The diet should be bland, very limited in quantity, and taken cold. If thirst be complained of, it may be allayed by sucking ice. As the patient improves, the diet may be cautiously increased. Alcohol should be avoided at first, but in a day or two port wine may be added, for it will be found a valuable astringent. In fact, in the earlier part of the century port wine used to be considered as indicated in all forms of hæmaturia. As the clots which have sealed the bleeding orifices are liable to become dislodged on the slightest straining, all vomiting and retching must be checked. Nutrient enemata must be administered if the patient continue to show a tendency to sickness.

Bowels.—In profuse hæmaturia the entire intestinal canal had better be kept quiet for a few days; purgatives are contra-indicated. I have seen a copious prostatic hemorrhage recur, and the case terminate fatally, on the exhibition of a purgative three days after a perineal lithotomy. On the other hand, if the abdomen gets distended, and solid fæces collect, they had better be removed by means of a rectal enema of oil or soap and water.

Morris[21] states "that he has seen sharp hæmaturia from an injured kidney brought on unexpectedly more than a fortnight after the infliction of the wound, and when the patient appeared to be convalescent, by the passage of hardened fæcal matter along the colon, and thus across the surface of the kidney."

Clot Retention.—The practitioner may find himself suddenly called to a case in which the bladder is full of clot and the viscus is felt like a hard mass projecting above the pubes. Under such circumstances, it is advisable to inquire whether the bladder has proved itself able

to evacuate its contents before the onset of the trouble, and if it has always worked well, it is wise to wait awhile and give the vesical muscle time to do its own work and rid the viscus of the clots. The pain should be subdued by means of opium and warm applications to the suprapubic and perineal regions.

If clot retention and vesical colic are not spontaneously relieved within a few hours, and the patient is obviously made worse by waiting, then the practitioner must intervene. A large-eyed soft catheter, which has been syringed through with oil, must be passed very gently. This may suffice—the clots and accumulated urine coming away, or most of the urine may be evacuated and the clots which cannot issue may be allowed to come away at a subsequent micturition. This manœuvre is not always successful, for the eye of the catheter sometimes becomes blocked with clot, and the retention is thus unrelieved.

A large-eyed silver catheter had then better be passed and warm boracic solution syringed in whenever the channel becomes choked. By alternately syringing in solution and sucking out clot and fluid the bladder will probably be cleared. When this is accomplished it is wise to throw into the bladder eight ounces of nitrate of silver solution (gr. i. ad ℥ viij.), which slightly coagulates the surface epithelium and prevents septic absorption.

Treatment of the Various Causes of Hæmaturia.

Carcinoma of the Kidney.

Medicinal.—Probably tincture of chloride of iron will prove most efficacious. Ergot or chloride of calcium may be exhibited for some time on the expectation of increasing the coagulability of the blood. The disadvantage of these styptics is the difficulty of getting rid of the clots they cause, for it is only at the expense of much renal suffering that they will be forced along the ureters. On no account should the bladder be sounded or washed out if a decided tumor is discovered in the loin. It may not be harmful, but it has been followed by serious, even fatal results.

Operative.—The statistics of nephrectomy for carcinoma are encouraging enough to permit us to hope that, with an *early* diagnosis, we may achieve a success in removing a renal carcinoma. Schede, of Hamburg, records a series of ten cases of nephrectomy without a death. Previous to this he had operated seven times with six recoveries, thus making a total of seventeen cases with one death. This, as the cases are not picked, shows how the mortality has decreased in the hands of a highly skilled general surgeon, for the statistics of

Gross showed a mortality of 44.6 per cent., of Brodeur 44.4 per cent., of Czerny 44.4 per cent., of Morris 30.4 per cent., and of Tait 18 per cent. Of the ten cases last recorded by Schede three were for carcinoma. No case is at present, I believe, published in which the renal artery has been tied to check hemorrhage and new-growth, though there is no reason why this should not be attempted. The future of nephrectomy in renal carcinoma depends upon a diagnosis being made and acted upon very early in the course of the disease; for the general feebleness of the patient and the intimate connections, whether inflammatory or neoplastic, which the kidney acquires with surrounding structures, render the operation very hazardous in itself, while the generalization which rapidly takes place makes operative interference useless if it is not undertaken soon after the degeneration has commenced.

I regard anæmia as an important contra-indication to operative interference.

As the tumor increases in size, it may press upon the vessels and strangle the blood-supply, or the renal pelvis and ureter may become filled with clot which will render that canal permanently impervious. In either case, the hæmaturia ceases.

Chronic Bright's Disease.

The hæmaturia of granular kidney is, I believe, best treated by absolute rest in bed, and a strict diet of milk. If the hemorrhage is not excessive, and the patient is able to get about, Turkish baths (without massage and the cold douche) may be taken with benefit and the bleeding often abruptly ceases in consequence, the free action of the skin reducing the congestion of the kidney. But if the hemorrhage has proved obstinate or profuse, it is better that the patient should keep to the bed, a hot-air bath being administered by means of a cradle and a spirit-lamp.

The most convenient form is that in which the air is heated in a receiver by means of a spirit-lamp, and is conveyed under the bedclothes, which are supported over the patient by means of an iron cradle. The following mixture may be given simultaneously with benefit:

℞ Tr. digitalis ..... ʒ i.
Tr. hamamelidis ..... ℥ ss.
Ext. glycyrrhizæ liquidæ ..... ʒ ij.
Aquæ destillatæ ..... q. s. ad ℥ viij.
M. ft. mist. Sig. Two tablespoonfuls three times a day.

All stimulating diuretics, such as juniper, turpentine, cantharides, copaiba, santal, or cubebs, should be avoided. The bowels had better

be acted upon very gently, preferably by means of rectal enemata of soap and water or glycerin.

The renal hæmaturia in syphilitics may be combated by ordinary antisyphilitic treatment, a valuable addition to the mixture being the compound decoction of sarsaparilla and the extract of hamamelis virginica.

The hæmaturia occurring in cardiac disease and in the acute nephritis grafted on chronic Bright's disease, must be treated on the usual principles laid down for these diseases.

Stone in the Kidney.

The appropriate treatment for hæmaturia caused by calculous disease of the kidney must be varied slightly according to the character of the urinary deposit. If the microscope or the eye detect a uratic condition of urine without pus, then moderate rest, a spare diet, avoidance of all alcohol, and the free use of alkaline waters, such as Contrexeville, Kronenquelle, or Wildungen, will usually suffice to check any tendency to hæmaturia. The bowels had better be regulated by a dose of phosphate of sodium (two teaspoonfuls) well diluted with water each morning. If the alkaline waters cannot be obtained, a teaspoonful of effervescing citrate of potash in half a tumblerful of water may be taken, or a very useful sherbet can be made thus:

℞ Potass. citratis ..... ℥ i.
Lithii citratis ..... ʒ ij.
Sodii biboratis..... ʒ vss.
Sacchari albi.....q. s. ad ℥ iv.
Ess. limonis..... ♏ xvi.
M. ft. pulvis.

Keep in a glass-stoppered bottle. A teaspoonful to be taken in a tumblerful of water twice a day.

Boracite of magnesia is advocated by Dr. Kochler of Posen (*Berliner klinische Wochenschrift*, Nov. 3d, 1879) for cases of uric-acid calculi and gravel. It is prepared by dissolving a natural borate of magnesia, which is found at Stassfurt, in citric acid. It may be taken twice or thrice daily in teaspoonful doses dissolved in a tumblerful of warm water.

Hemorrhage in oxaluria and oxalate of lime calculus is perhaps more difficult to arrest. No brusque movements should be allowed; the diet must be stricter, and free from sugar in any form; all uncooked fruits ought to be avoided. Usually the acids in some bitter infusion succeed best. The following is valuable:

℞ Acidi nitro-hydrochlor. dil..... ♏ xl.
Infusi rosæ acidi.....q. s. ad ℥ viij.
M. ft. mist. Sig. Two tablespoonfuls between meals thrice a day.

Hemorrhage, when due to phosphatic calculi, in which the urine is usually alkaline, often abates on the exhibition of the citro-borate of magnesia, or after a combination of boric acid and benzoate of soda with infusion of chiretta or serpentary. If there is pus also present in the urine the balsamic drugs are of value when taken at night after supper: turpentine, five drops in capsule; copaiba oil, ten drops; santal oil, ten drops cautiously increased. The diet must be liberal and varied, and some form of stimulant should be added. Skilled nephrolithotomy, if no suppuration has taken place, is free from risk.

The Hæmaturia of Benign or Malignant Growths.

No drug can be relied upon to check a well-established hemorrhage from vesical growth, whether benign or malignant. Any or no drug will suffice in the very early stages, gallic acid and opium being perhaps as good as any. Every hæmostatic may be tried in turn, and one may be chanced upon which suits the patient and holds the loss in check. Should at any time the bleeding become alarming, much good can be done by the passage of a soft Jacques catheter in order to *partially* empty the bladder—the final contraction of the viscus and the consequent traumatic escape of blood from the growth is prevented by leaving an ounce or two of urine behind. If this fails, vesical irrigation should be tried. I know of few better injections than hot hazeline, or hot hazeline and water (equal parts). Prout recommends that twenty to forty grains of alum, dissolved in a pint of water, should be injected into the bladder. He says: "This remedy seldom fails to check the bleeding even when the cause is malignant disease. I have never known any unpleasant consequences follow the use of this expedient, and I have seen it immediately arrest the most formidable hemorrhage when all other means had failed, and when the bladder had repeatedly become again distended with blood almost immediately after its removal."

Sir Henry Thompson has great confidence in astringent injections thrown into the bladder with extreme gentleness, and through a small catheter. The two which he uses for cases in which operation is not as yet decided on, and especially for those in which the tumor has been only partially removed, are perchloride of iron and nitrate of silver. "The strength employed is from twenty to sixty minims of the tincture of the perchloride of iron in four ounces of cold water, to be used daily once or twice according to circumstances; of the nitrate of silver, from gr. i. to gr. vi. in four ounces of water, the stronger solutions being rarely tolerated or necessary."

I have, personally, the greatest objection to using styptic injections and very rarely employ them. They are often provocative of cystitis.

Now cystitis militates against a successful removal and a rapid cure of a benign growth, while it is the turning-point in the life of a malignant vesical tumor. After cystitis has been *induced*, or upon its appearance in vesical carcinoma, there is an immediate increase in the pabulum of blood which is conveyed to the malignant mass and utilized in its construction. All the misery and pain caused by irritative cystitis and the necrosis of the surface of the tumor are, therefore, summoned weeks or months before they otherwise would appear if the disease were permitted to take its course.

Operative Interference.—The suprapubic removal of vesical growth of the benign type ought to be free from risk if it be undertaken before degenerative changes in the kidney have ensued. A fatality in straightforward cases is a surgical discredit. Any interference with the surface of a benign growth checks the bleeding for months. This is not so in all carcinomata; nothing short of free surface removal stops the hemorrhage.

Primary Tuberculosis of the Kidney and Bladder.

This hemorrhage is rarely of much moment, and the treatment of it is the same as that which is usually directed against inflammation or ulceration of the genito-urinary mucous membrane. Of drugs the oil of sandalwood is the best. It is taken in capsules in doses of five minims, cautiously increased to fifteen, thrice a day after food.

If the renal pain is aggravated by its use, the balsamic oil had better be at once replaced by a less stimulating drug, such as citrate of potash, boric acid, or benzoate of ammonia. In all cases preparations of opium are of value, and later on the orthodox cod-liver oil. The patient should be sent for change of air, and have a liberal and fatty diet. Change to the sea-side for town-dwellers, and to an inland dry climate for those living on the seaboard, is usually sufficient to hold the hemorrhage in abeyance.

In the earlier stages of tubercular ulceration of the bladder the bleeding may be checked by the administration of santal oil or maltine, and in some cases by the insertion twice a day of a rectal suppository of morphine. As a last resource a single but thorough washing out of the bladder with boiled filtered water will often be quite sufficient to check even smart hemorrhage due to vesical ulceration in the earlier stages. As the disease progresses, tincture of witch hazel, a drachm to the ounce of boiled water, may be used, or five grains of iodoform suspended in an ounce of mucilage may be thrown into the bladder and left in, or lactic acid 1 per cent. may be injected to overcome the tendency to phosphatic deposits which induce and keep up hæmaturia. There is, however, great need for extra circumspec-

tion as regards cleanliness and gentleness in dealing with tuberculosis topically. In the later stages when the prostate has become involved, it is better not to wash out the bladder or to pass any instrument through the deep urethra at all. I have known bleeding from deep ulceration resist all remedies and yield only to drainage, but this step should be a last resource.

Stricture of the Urethra.

The hemorrhage due to stricture usually subsides on gradual but free dilatation and the use of nux vomica and alkaline mixtures.

Stone in the Bladder.

As this usually subsides in proportion as the pus in the urine increases, it will only be in the earlier stages that advice is sought for on the score of hemorrhage. Any hemostatic combined with opium will stop the bleeding, but nothing but the removal of stone will of course cure it. If prostatic engorgement coexists and the sounding has been severe, the hemorrhage may persist for a long time. In the latter case gallic acid and opium had better be administered in addition to the routine remedies for allaying cystitis. If the patient is forced to move about, the injection into the bladder, thrice a day, of an ounce of warm oil, with which a teaspoonful of tincture of witch hazel has been thoroughly mixed, will often be sufficient to allay irritation and check hemorrhage.

Prostatic Congestions.

The slight bleeding in prostatic congestion due to gonorrhœa or to sexual excesses is probably beneficial. If, however, it shows any tendency to profuseness, ice in the rectum is indicated. If this does not arrest the loss, any of the balsamic remedies are of service, and in addition gallic acid and opium should be administered. Gross asserts that frightful, even fatal hemorrhage has been occasioned by masturbation. I have never met with such a case, but I have encountered violent hemorrhage due to reckless instrumentation of a prostate swollen and inflamed by masturbation, and I was forced to do a perineal section and remove the clots by means of a powerful syringe before I could clear the bladder. So untoward an event can but seldom occur.

Senile Prostatic Enlargement Without Vesical Atony.

The hemorrhage in many of these cases is beneficial, free from danger, and yields to recumbency, acidulated drinks, and gallic acid and opium. Ergot has occasionally appeared in my hands to

increase the bleeding. It is surprising for what a length of time clots will remain in healthy acid urine, without undergoing bacterial decomposition. They slowly disintegrate and are passed like tea-leaves or slips of light tan. For this reason I should advise that the catheter be not hastily used unless the bladder is atonic and unable to cope with the obstruction caused by the clots. If, however, the urine is alkaline and ammoniacal, cystitis from the decomposition of the clot will rapidly develop, and the catheter must be used at once to anticipate this, the bladder being thoroughly washed out. The hemorrhage which ensues in cases of enlarged prostate in atonic bladders is often difficult to treat.

In a clinical lecture upon hæmaturia at St. Peter's Hospital, my colleague, Mr. Harrison, made the following very apt and valuable remarks, apropos of this subject: "There is, however, a condition of the senile bladder which adds considerably to the trouble connected with bleeding. I refer to those instances where it occurs with a large prostate, and an atonic or almost completely atonic bladder. The great safeguard against prostatic hemorrhage is the power of the bladder to exercise pressure. In two instances not only had I to empty the bladder of blood, but to keep it empty by pressure upon it and the retention of a catheter until the tendency to bleed had ceased, just as is done with the flaccid uterus. In both the instances I refer to this was successfully accompllshed, and the patients recovered, though the loss of blood was considerable. It is not the least use depending upon hemostatics in cases such as these. The mechanical reason why the bleeding will not cease must be recognized and acted upon, or the patients will flood to death, with their bladders distended with blood up to the umbilicus."

PYURIA.

When pus is passed in urination, the symptom is known as Pyuria. Our knowledge of the causes of this morbid change is, however, inexact, for it is often impossible on clinical grounds to judge of the source of the pus, while with the cystoscope it is equally difficult to make sure that the changes which are seen in the mucous membrane of the bladder indicate the only area from which the pus is emanating.

Micro-Chemical Characters and Tests for Pus.

Pus is partly composed of a liquid portion—the liquor puris—and partly of solid cellular particles—the pus corpuscles. The liquor puris, which is merely liquor sanguinis, contains a variable amount

of albuminous constituents, and urine, therefore, which contains pus must also show evidence of albumin in proportion to the amount of pus present. It is often a matter of considerable difficulty to decide as to whether the amount of albumin present can be accounted for by the pus, or whether there is albumin from renal degeneration superadded.

This, however, will be treated of under the head of accidental albuminuria. The pus cell microscopically is spherical and larger than a blood corpuscle, having a diameter of $\frac{1}{80}$ to $\frac{1}{100}$ millimeter, and is heavier. Sometimes it is irregular in shape from the processes it sends out.* Spherical forms mark transitory pyurias. If water is added the cell becomes larger as well as clearer. If acetic acid is added the nucleus will be seen divided into three or more nucleoli. Similar changes occur in the urine. If the secretion be acid and concentrated the pus cells appear small and granular, if the urine be alkaline or of low specific gravity the pus cells are large and swollen. The chemical test for pus in the urine is identical with one of its chief clinical characteristics. If liquor potassæ or liquor ammoniæ be added to puriform urine, the pus becomes converted into a viscid mass (Donné's test). Puriform urine is always more or less murky.† In acid or neutral urine the pus sinks to the bottom of the glass and forms a more or less thick creamy layer. But in urine alkaline from ammoniacal decomposition, the pus is transformed into a clear viscid, glairy, tenacious mass. To distinguish between pus and mucus‡ when both are present is often difficult: it is advised to add mercuric chloride, which precipitates the pyin but not the mucin; this is filtered off and the filtrate containing the mucin is precipitated by acetic acid.

The Source of Pus in the Urine.

Pus may emanate from any part of the urinary tract or may break into it at any point and be discharged along with the urine. The source is decided upon after careful examination of (*A.*) the urine, and (*B.*) the patient.

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* Vogel calls attention to this difference in pus cells in the urine, and declares that their occurrence in the irregular form affords a much less favorable prognosis than when they are globular (Ultzmann).

† Bacteria may render the urine murky and the cloudiness may be considered as entirely due to pus. Pus must of course be present, but it may be in small quantities, the acuteness of the inflammation associated with the bacteria having subsided. It will be noticed that bacterial clouds are very long in falling to the bottom of the glass—but the microscope settles the point.

‡ Tyson says: "The pus corpuscle is a cell too rapidly produced to develop into normal tissue, while the mucus corpuscle is only accidentally arrested in its development." ("Guide to the Practical Examination of Urine," 4th ed., p. 153).

A. Examination of the Urine.

1. *A large, thick, creamy deposit of pus in acid urine* is generally due to disease of the upper urinary passages, *e.g.*, pyelitis, chronic pyelonephritis. It separates much more quickly than does pus from the bladder, and the sample may remain acid and free from micro-organisms for days. The secretion of urine is usually abundant.

2. *The constant presence of viscid, glairy muco-pus* marks a vesical source. This is absolutely correct if taken in conjunction with bladder symptoms. Once or twice I have been deceived by patients bringing me a bottle of urine, with a large clump of phosphatic muco-pus slightly coated with blood, and with the assurance that this clump was never seen in the day but was only passed on rising. Cystoscopically one or other ureteral orifice was seen to be inflamed, swollen, and pouting; the surrounding mucous membrane was papillated, as if fretted by irritating discharges. These cases puzzled me, for clear urine jetted out of the ureters and I considered the kidneys were healthy. One patient was, however, seized with a sudden attack of severe renal pain, a symptom he had not suffered from for many years. He was admitted into another hospital and nephrolithotomy was performed, several large calculi being removed. I have since realized that these cystoscopic appearances indicate irritation of the renal pelvis, and account for the morning appearance of a clump of muco-pus by the fact that residual urine acts in the renal pelvis during the hours of recumbency exactly as residual urine in the inflamed bladder, undergoing ammoniacal changes.

3. *Intermittent Discharges of Pus in the Urine.*—When large amounts of pus appear intermittently in the urine, it is nearly always derived from the pelvis of the kidney the ureter of which has become temporarily obstructed by a plug of muco-pus, or by slight twisting of the canal. It may, however, in rarer cases emanate from some extra-urinary source, the channel of communication with the tract becoming periodically closed. The symptoms of fever which accompany the non-evacuation of the pus, but which subside on its release, are additional evidences of the pent up condition; while the pain induced by the tension is generally a guide to the anatomical source of the discharge.

4. *Threads or Flakes of Pus.*—If flakes or threads of pus are passed in the urine, the source is usually urethral. In the large majority of cases this is quite reliable. The threads or pus fibres are formed by the issuing stream of urine sweeping out casts of ducts leading into the urethra, or rolling up flakes of pus and sodden epithelium which cover granular patches and post-strictural congestions. Those

threads which are thin and long usually come from the anterior urethra, while those which are broad and thick emanate from behind the compressor urethræ muscle.

It is, however, worthy of remark that pus flakes come from other parts of the tract. I have known them in inflammation of the renal pelvis, and in renal stone, while in tuberculosis of the bladder and prostate flakes and scraps are of frequent occurrence. I have seen long flattened threads made by thick pus being forced into the bladder from a peri-vesical abscess. It is wise, therefore, before deciding that the source of the threads is urethral, to try the three-glass test.

The Three-Glass Test.—The good old-fashioned test of making the patient urinate into two glasses is of value. Into the first are carried the sweepings of the urethra and into the second is passed the rest of the secretion. This has been modified, and with advantage, by washing out the anterior urethra with boracic solution or with a $\frac{1}{16}$ per cent. salicylic acid solution (Keyes). If pus is found in the first glass or in the washings, and the second glass sample is normal, the origin of the pus is obviously in front of the compressor urethræ, and the bladder is free. At the present date this test has been still further extended by Finger, Sehlen, and others, so as to embrace morbid additions from the prostate and seminal vesicles. After the patient has cleared the urethra by urinating an ounce or two into a glass, the well-greased forefinger is passed into the rectum and the prostate is massaged lightly downward. By this means its contents are pressed into the prostatic canal and are swept into another glass by another jet of urine. Lastly the remainder of the urine is passed into a third glass. If any doubt now remains as to whether the kidney or the bladder is furnishing the pus, the recommendation of Sir Henry Thompson is to be followed: A soft flexible catheter of medium size is passed into the bladder, the patient standing, all the urine is drawn off, and the viscus is washed out by repeated small injections of warm water. The urine is then permitted to pass along the catheter, as it will do, guttatim, into a test-tube or other small glass vessel for purposes of examination. "The bladder," says Sir Henry Thompson, "ceases for a time to be a reservoir, it does not expand but is contracted round the catheter, and the urine percolates from the ureters direct. The ureters are virtually lengthened as far as the glass. Thus is obtained a specimen which for appreciating albumin, for determining reaction, and for freedom from vesical pus and even blood, and from cell growths of vesical origin, is of considerable value, and has sometimes furnished me with the only data previously wanting to accomplish an exact diagnosis."

5. *The Amount of Albumin Present in Puriform Urine.*—The urine

of pyelitis always contains albumin in excess of that due to the pus present in the secretion, the addition marking the implication of the renal structure. When one-half to one per cent. by weight of albumin exists in a filtered acid specimen of puriform urine, without blood, involvement of the pelvis of the kidney in the inflammatory process may be suspected. In decomposed urine containing pus, little can be inferred from the albumin tests (E. Fuller).

6. *The Microscopy of Purulent Urine.*—Much stress is laid upon this by many authorities. It is asserted by Ultzmann that short, thick cylinders formed by the aggregation of pus cells come from the papillary ducts and are of great diagnostic importance. He mentions also that renal epithelial scales baked as it were into pus casts, and isolated epithelial cells coming from the main ducts of the urinary tubules, are recognizable. This is in accordance with the teaching of continental authorities. The accurate recognition needs, I am sure, long practice.

In calculous pyelitis blood corpuscles are often present and a variety of crystals which correspond to the stone in process of formation.

In tubercular cases the débris may show the bacillus on double staining, but this can only be discovered after much examination and in fresh acid urine. A rabbit should always be aseptically injected with the freshly passed urine, and culture experiments made in doubtful cases. When during a chronic pyelitis there is an exacerbation of fever, short and thick granular casts are found during the first few days coming from the larger urinary tubules. Klebs directs attention to large clumps of bacteria and cocci, and states that these emanate from the straight tubes, and describes them as characteristic of "pyelonephritis parasitica."

B. Examination of the Patient.

A careful examination of the patient should be undertaken for evidences of disease in the region in which pain is complained of. The kidney is palpated for the detection of tenderness on pressure, of enlargement, or of excessive mobility; calculus, pyelonephritis, tuberculosis, and pyonephrosis being the main causes of an excessive amount of pus in the urine. The bladder should be examined bimanually, both when empty and when full. Inflamed bladders are always tender. Carcinomatous or tubercular deposits are nearly always recognizable, and calculi when large can be felt through the base.

The prostate, vesiculæ seminales, vasa deferentia, and epididymis, are examined for tenderness, enlargement, or deposit of tubercle. The projection of stone in the prostate is detected by the hardness and grating, for they usually are multiple. The bougie will eliminate

stricture, and the sound will serve to detect prostatic or vesical stone. Both instruments should be passed with the same precautions as those laid down in the article on hæmaturia, but the objection to using them is less in pyuria than when blood only is present. The cystoscope will demonstate a stream of pus issuing in a dull muddy current from either ureter, and will establish the presence or absence of vesical causes for pyuria. The spine and ribs are thoroughly searched for tubercular lesions, which may be discharging their pus into the upper urinary tract. The uterus and its surroundings are examined in the knee-and-elbow position, in order to ascertain if any inflammatory adhesions exist between these organs and the bladder; while in hip disease the inner side of the true pelvis is thoroughly swept by the finger in the rectum, to make sure that no abscess from the obturator cavity is approaching or discharging into the bladder.

The Significance of Pus in the Urine.

The mucous membrane of the urinary tract seems specially prone to become irritated in middle-aged and elderly people. "Exposure to cold," says Ralfe, "the passage of urine loaded with urates, oxalates, or phosphates will cause the presence of pus cells in the urine. Even the use of highly seasoned dishes will often produce a catarrh of the mucous membrane, in feeble and delicate persons, sufficient to lead to the formation of pus corpuscles." The transient appearance of slight amounts of pus in the urine need not, therefore, cause alarm nor arouse suspicion that the integrity of the kidneys or urinary channels is being threatened; but the persistent admixture of pus with the urine in visible quantities demands close investigation and often creates anxiety lest serious organic changes are in progress.

Diagnostic Significance of the Symptoms Accompanying Pyuria.

In mild gouty pyelitis, or mild cystitis, or pyelitis, especially when this occurs in the female, there may be no symptoms present to indicate the source of the pus. This is exceptional, for pyuria is usually accompanied by symptoms of functional distress in the organ which is inflamed, and the patient is often able to localize the site of the trouble almost as surely as the medical man. Cases will, however, be met with in which the diagnosis is by no means easy on account of the conflicting nature of reflex symptoms, for one inflamed portion of the urinary tract may excite another reflexly or by "sympathy," or acrid pus flowing from an upper source may directly irritate, in its transit, a lower section of the channel. Complex and misleading symptoms are thus evoked and attention is drawn to an organ

which is not seriously at fault. A brief consideration of these exceptional conditions may not be amiss.

Reno-Vesical Reflex.—It has been known since the times of Valsalva that certain diseases of the kidney are liable to produce a most distressing irritability of the bladder. A common illustration of this fact is met with occasionally in cases of acute parenchymatous nephritis. The onset of this disease is sometimes heralded by a distressing and urgent frequency of micturition. This symptom usually passes away in a few hours, to be replaced by the characteristic features of the disorder, but it is sometimes so severe while it lasts as to mislead the practitioner into believing that the patient is attacked with acute cystitis. The bladder is also sometimes affected in the same manner in *chronic* diseases of the kidney. Morgagni [26] speaks of a patient who complained of very little pain in the region of the kidneys, while he was tormented with pain in the bladder so excruciating in its intensity that five or six physicians who attended him entertained no doubt of the seat of the disease being in that viscus. On post-mortem examination no morbid appearance was discovered in the bladder, but there were large and ramifying calculi in the kidney. Attention has been particularly directed to this subject by Sir B. Brodie,[27] who records two cases in which post-mortem examination completed the clinical history. The first instance was that of a gentleman who voided his urine frequently and in quantity varying from an ounce to an ounce and a half. Always after making water he had a severe pain, lasting a few minutes and extending along the urethra. The urine was pale, semi-opaque, of an acid quality, and when tested with heat and nitric acid it was found to be highly albuminous. Occasionally small masses of a substance resembling coagulated albumin were seen floating in it. He made no complaint of pain in the loins, he was able to empty his bladder by his own efforts, and the urethra was free from stricture. There was no calculus in the bladder, nor had any sand or gravel ever been observed in the urine. These symptoms had existed ten months and latterly had gradually increased. For a short time the urine had been tinged with blood. In addition to these local ailments the general health was much impaired, the patient had lost flesh, was languid, dejected, and of a pallid countenance. Soon after Brodie was consulted the urine again became tinged with blood. The bodily powers continued to fail, and the local symptoms became more urgent. There was a total loss of inclination to take food, the extremities became cold, the pulse grew feeble, and the man died.

On examining the bladder after death the kidneys were found to be of a dark color from excessive vascularity, and of a soft and some-

what brittle consistence, the distinction between the cortical and tubular portions being less marked than under ordinary circumstances. The investing membrane of the kidney had a very slight adhesion to the kidney itself, but it adhered closely to the adipose substance of the loin. On the surface of each kidney, and partly embedded in its substance, were four or five membranous cysts, each of the size of a large pea, and in one of the kidneys there was a similar one the size of a nutmeg, completely embedded in the cortical substance. The pelvis, infundibula, and ureters were not more capacious than under ordinary circumstances, but on being split open their internal membranous substance presented the evidences of considerable inflammation.

It could not be said that the bladder was found altogether free from disease, but the morbid appearances were so slight, compared with those observed in the kidney, that it seemed impossible to doubt that the last-mentioned organ had been the seat of the primary disease, and that the bladder was affected only in a secondary manner. It was contracted and the muscular tunic was somewhat thickened, but not more so than must have been the case in a person who from any cause had been teased for a considerable time by an incessant inclination to void his urine.

I have encountered several instances lately,—one of an adult who had such irritability of the bladder and such agonizing pain on micturition* that a colleague performed suprapubic cystotomy. After death a month later the entire left kidney was found transformed into a sack of pus and the ureter was much thickened and almost impervious. No tubercle existed anywhere. Another case was that of a lady who for many years had been tormented by frequency of micturition but by no actual pain. Lately she had suffered from pain of a very severe character in the urethra independent of micturition. The free exhibition of morphine became necessary. On cystoscopy the bladder was found to be quite free and capable of containing many ounces, but an intensely sensitive right renal tumor was discovered, and this probably was the cause of the vesical symptoms. It must be remembered, however, that such cases are undoubtedly rare, and it is generally the acrid pus flowing over the sensitive neck of the bladder and irritating it, or the descending effects of tuberculosis, that produce vesical symptoms in renal disease. Conversely cases occur in which the renal pelvis becomes inflamed and sensitive from ascending pyelitis of simple or tubercular character, and the pain is felt mostly in the more recently attacked parts.

* Compare case by M. Reliquet quoted in the section on hæmaturia.

The following illustrates this latter point:

A lady of sixty, who at the age of thirty had suffered from pyuria for seven years, and who had complained for thirty years of an aching left kidney, was suddenly seized with symptoms of epidemic influenza. On the third day of the attack the left kidney became swollen and tender and pus again appeared in the urine from which it had been so long absent. I performed nephrotomy and evacuated and drained a large abscess in the cortex; there was a small sinus communicating between the sac and the pelvis. The urine promptly cleared, but as soon as the drainage-tube became blocked, frequency of urination and scalding were suffered from, but subsided on the re-establishment of the discharge into the dressings. This train of symptoms happened on several occasions.

Even in tubercular disease of the kidney when the bladder is slightly implicated, the vesical symptoms are greatly ameliorated if not entirely subdued by diverting the acrid pus through a nephrotomy wound. A well-built young fellow came to me complaining of frequency of micturition. This he had had for six months. Latterly he had been unable to work on account of a griping pain which used to seize him in the lower part of his belly and double him up. The spasm was at once relieved by passing water. Cystoscopy revealed an ulceration at the base of the bladder on the right side, and rectal examination showed that the right lobe of the prostate contained a small deposit of tubercle. In a few weeks the temperature began to oscillate, the right kidney became tender. Nephrotomy was performed, and an abscess evacuated from the cortex. All the symptoms of vesico-urethral disease thereupon disappeared.

In rare cases the local symptoms are excited by pus flowing into some part of the conducting or collecting channels, and unless the real source of the pus is discovered the irritated organ will continue not only to mislead but also to cause the most skilful and assiduous treatment to miscarry.

Extra-Urinary Sources of Pyuria.

The source of the pyuria which is occasioned by an abscess bursting into some part of the urinary tract is usually located without much difficulty. Much depends on the cross-examination of the patient regarding the onset of the trouble. The symptoms are compounded of those specially evoked by the original suppuration and of those referable to that section of the urinary apparatus which is thus irritated. A neighboring bone lesion, some source of inflammation in the female pelvis, or perchance some external pyæmic attack

coupled with the prodromes of an acute abscess and with the local pain which it evokes, taken in conjunction with the subsequent distress of that part of the urinary tract which it is approaching, will warn the practitioner of the probable cause and course of the disturbance. The abrupt relief from symptoms of tension, coincidently with the sudden appearance of a large quantity of pus in hitherto normal urine, its subsequent intermittent discharge, and the functional irritability of the viscus into which it is escaping, will confirm the diagnosis of the cause of the pyuria and the site of the irruption of the morbid product.

One of my first cases for electric cystoscopy was that of a lady suffering from profuse pyuria, from a residual abscess due to caries of a rib. The history of the patient was as follows:

Twenty years ago she had had strumous caries of one of the right lower ribs. A deep scar not far from the right renal region marked the orifice of the abscess which then existed. In January, 1887, a sudden attack of pain in the scar region was complained of, and the symptoms which followed resembled biliary colic. The pain continued off and on, gradually descending, however, at each attack somewhat lower in the abdomen until it became very similar to renal colic. Eventually extreme pain was experienced in the bladder, and frequency of micturition, with evidences of acute cystitis, supervened. Various special opinions had been taken, as regards both the uterus and the kidney, but these were very conflicting and for the most part undecided. On cystoscopy the bladder was seen to be covered with hemorrhagic petechiæ, which were more numerous toward the orifice of the right ureter. A dull, flapping stream of dark, murky pus issued sluggishly, but at regular intervals, from the right ureteral orifice. The left ureteral opening was small, and was ejecting healthy urine. The pus was evidently coming from the right renal pelvis, and this taken in conjunction with the scar and the history of the recent attack, established the diagnosis of an extra-urinary abscess. After some months the pus diminished and then ceased, and the lady recovered her health and strength completely.

Pyæmic Abscess in the Cellular Tissue of the Female Pelvis, emptying into the Bladder by a Minute Aperture; Cystoscopy, Laparatomy, Cure.—A lady, aged 37, under Dr. Valentine Rees of Brecon, was sent me for treatment for a constant pyuria and for a most troublesome pain in connection with the bladder. Nine months previously she had had a pyæmic attack with multiple abscesses in various joints due to a miscarriage. After these had been freely opened and had healed, sudden and severe pelvic pain with constitutional disturbance supervened. This was followed by great irritability of the bladder, which culminated in the discharge of a large quantity of pus in the urine. The symptoms indicated that a pelvic abscess had opened into the bladder or lower ureters, but the exact site was uncertain. Heavy doses of morphine injected into the bladder became necessary, for her life was otherwise unbearable from severe perivesical and

urethral pain and from straining and frequency of micturition. The morphine gave her perfect freedom from pain and ability to hold her water five hours. The urine was acid and contained a variable amount of creamy pus, its specific gravity was 1.020. Latterly the pus had been noticed in the form of long, thick, taper-like pieces. *Cystoscopy:* Bladder held eight ounces of fluid easily. The mucous membrane of the posterior wall had lost its sheen, and the muscular fasciculi were becoming hypertrophied. There was no abscess opening. The surface of the left wall low down was heaped up in enormous folds of œdematous and inflamed mucous membrane. So much was this swollen that it looked like a gelatinous epithelioma. The right lateral wall was covered by a similarly swollen mucous membrane, but this change from the normal extended over a wider area and was more pronounced. As I was watching the latter surface I saw a most remarkable sight. From a minute crack in a depressed furrow between two prominent folds a long tapeworm-like body was being gradually extruded. It was flat, white, and square-ended. After one-third of an inch had protruded, it broke off by its own weight and fell heavily to the base of the bladder. I followed it to its resting-place and found a small collection of similarly flattened, ribbon-like white bodies. Returning to the crack I saw another in the process of being forced out. My assistants, my anæsthetist, Mr. Woodhouse Braine, and I watched this performance with great curiosity for some time. It never ceased. I washed out the pieces of ribbon and measured them. They were about one-third of an inch long, one-sixteenth of an inch thick, and about one-eighth of an inch wide. The diagnosis was at once established. An abscess, probably ovarian, had burst into the right side of the bladder, and was now probably obsolescing. The patient was advised to wait three months longer, which she did without benefit. I therefore, guided by the cystoscope, passed a probe through the urethra to the vesical opening of the sac. As the probe dilated the opening a rush of thick fluid pus issued, and nothing more was seen. The patient was at once elevated into a Trendelenburg position, and a median laparatomy was performed, the probe being retained in position as a guide. Adhesions being broken down, the intestines were lifted out of the pelvis and an electric light thrown down on to the floor of that cavity; it was then seen that the abscess was beneath the peritoneum and unconnected with the ovary. The wound was, therefore, closed and the vesical opening of the abscess dilated with the probe as far as possible. An incision was made through the vaginal roof on to the floor of the abscess wall but not opening into it. There was no reaction, and the patient returned home in three weeks. The subsequent course was uneventful. Pus gradually diminished, pain and frequency of micturition ceased, and the patient reported herself cured in about four months' time.

Hydatid Sac Bursting into the Left Renal Pelvis, Subsequent Suppuration.—Hydatid sacs in the cellular tissue in the neighborhood of the kidney evince a singular tendency to burst into the pelvis of that viscus. Occasionally they suppurate, probably because of the propinquity of the colon. One patient, of seven cases of urinary hy-

datids, brought with him a seven-ounce bottle of pus, cysts, and thin gruel-like urine, as a sample of what he passed daily for some weeks. He had had an hydatid cyst the size of a fœtal head, which occasionally emptied itself into the renal pelvis, for thirty-one years. A month previous to consulting me the contents of the sac had suppurated, and he began to pass more cysts than he had done during the thirty years of his illness. He refused operation, and got quite well under ordinary medicine, the colic and fixed pain ceasing, the urine clearing, and the sac contracting until it was quite small.

External Pyæmia, Acetabular Abscess Bursting into the Bladder Three Times, Scar in Bladder Seen with Cystoscope.—A young fellow, aged 30, was sent to me by Dr. Ayling for an acute attack of cystitis. In 1878 he suffered from "pyæmia" in Germany, his left hip and right knee suffering most severely, and ankylosing. In 1884 the old abscess in the left hip opened, and in 1885 an abscess formed apparently on the inner side of the acetabulum, for the patient states it burst into his bladder and discharged pus and blood into the urethra, the pain ceasing at the same time in the hip. These abscesses have formed three times, and they have always evacuated themselves by the same route. In 1886 an abscess dischagred by the rectum and a piece of bone came out. Apparently this was the conclusion of the disturbance, for he has since been in perfect health until the attack for which he presented himself to me.

A month previous to seeing me he began to suffer suprapubic pain *after passing water.* It was not in the penis at first. There was no frequency of urination and no blood. A week before seeing me he was suddenly seized while micturating with a severe pain at the inner side of the suprapubic area and along the penile urethra to the glans. This continued, became constant, and was quite independent of micturition. He urinated every three hours in the day, and once at night; when the call came it was urgent but not imperious; the stream was twisted and curled. He was in terror lest another abscess was forming. The left hip was ankylosed and covered with deep scars both before and behind. The urine was acid, 1.020, straw-colored, clear, contained one-eighth albumin, irregular-shaped uric-acid crystals, but no casts. With the electric cystoscope I found he had a well-marked patch of sessile warty growth, the size of a threepenny bit, on the left side of the lateral wall low down. This patch was situated on a healthy base, and the neighborhood was uninflamed. The rest of the bladder was healthy. From his history and the unusual appearance of the splash of warty growth, I felt justified in considering that it was the index of an irritation which had approached the bladder from without, and probably had been induced by the abscess which had burst thrice into the bladder from the neighborhood of the left hip.

Fallacy.—Cases are on record of psoas abscess breaking into the bladder,[24] and even carrying pieces of bone into that viscus, but it is, I believe, comparatively uncommon for these abscesses to break into

the ureters or kidney pelvis, for if they do affect this urinary channel it is rather by occluding the ureter, and by producing disorganization of the kidney.[29] In dealing with these cases of angular curvature of the dorsal spine, it is unwise to conclude hastily that urinary symptoms betoken the irruption of pus into the tract from a spinal collection; it should be remembered that frequency of micturition and pain at the end of the penis, together with small amounts of pus in acid urine, are caused by independent tubercular disease in the renal substance. Still more unlikely is a psoas or an iliac abscess which projects into the groin or loin to affect the urinary passages, for it has obviously made its way in another direction. I have made two post-mortems which illustrate this.

A man aged 50 developed a psoas abscess in his left thigh which had emanated from caries between the fourth and fifth lumbar vertebræ, a curvature at this spot having existed for fifteen years. Pus was passed with the urine. This psoas collection was opened, but the pus in the urine did not diminish. On post-mortem the left kidney was found entirely destroyed by tubercular disease, and the left psoas abscess had no connection with either the ureter or pelvis of the kidney.

A man aged 51 presented himself with a large psoas abscess the size of a child's head simulating inguinal hernia of the left side. The urine was acid and contained much pus, the specific gravity was 1.010. The psoas abscess was opened. On the death of the man from hectic and exhaustion a few days after, a post-mortem was made and the abscess was tracked to the caries of the first sacral and last lumbar vertebræ. It was quite unconnected with the urinary tract. The left ureter was enormously thick, its canal was patent, and the mucous membrane was tubercular. The renal pelvis and one or two calyces about the middle of the kidney were also implicated, while the bladder was patched over with crude tubercle and superficially ulcerated. The trigone and adjoining posterior wall had been cleanly dissected up. The right kidney was healthy. Probably there was direct contagion from the psoas to the ureter, through the medium of the lymphatics.

The Chief Urinary Diseases Producing Pyuria.

Presupposing that the source of the pus has been determined, the exact cause for its production must be decided upon. This necessitates a brief consideration of the chief symptoms which accompany pus emanating from (1) the renal pelvis, (2) the bladder, and (3) the urethra. Seeing, however, that the pyurias of the lower urinary tract come more into the province of the surgeon, attention will rather be paid to the pyelitic diseases, and the reader is referred to the sections on diseases of the bladder and of the prostate for a detailed account of cysto-prostatic disorders.

The inflammatory diseases of the pelvis and kidney are properly embraced by the terms pyelitis and pyelonephritis, while pyonephrosis is retained to indicate an accidental stage of either, being dependent on intermittent obstruction to the outlet from these inflamed parts.

Pyelitis is either primary or secondary. In the former it has originated in the kidney or its pelvis, and in the latter it has extended to this section from the lower urinary tract. It is of importance to obtain a correct history of the symptoms marking the onset of pyelitic pyuria, for a distinction between primary and secondary pyelitis, which is often possible by means of this knowledge, is a matter of much surgical moment.

Primary pyelitis may arise either from the chemical action of drugs, such as cantharides, turpentine, balsams, diuretics, or from that of the products of micro-organisms of general diseases, such as typhus, pyæmia, influenza, tuberculosis, which irritate the kidney substance and mucous membrane of the pelvis, as they are eliminated through these great depuratory centres. It may, moreover, be provoked by mechanical causes, as is seen in a hydronephrosis becoming fouled by the bacilli of the adjoining colon. Secondary pyelitis is evoked by the direct extension upward of inflammation from the bladder, prostate, or urethra, such as obtains in vesical calculus, obstructing vesical growth, enlarged prostate, stricture, and gonorrhœa. It is said that the urine in primary pyelitis is usually acid and will often remain so for days, while that in secondary pyelitis is neutral or alkaline, and that it rapidly decomposes. Moreover, Ultzmann asserts that primary pyelitis is never accompanied by frequent or painful micturition, while the pyelitis which is propagated from the bladder or prostate usually is accompanied by these symptoms. I am sure that this cannot be accepted, for pyelitis produces an irritability of the lower urinary tract either reflexly or by the acrid discharge from the renal pelvis irritating the neck of the bladder in its exit. (*Vide* Reno-vesical Reflex, p. 592.)

Primary Pyelitis.—The general diseases which affect the pelvis of the kidney and evoke a pyuria are many and various. The acute forms include such infectious complaints as diphtheria, pyæmia, septicæmia, typhoid fever. In this a mere catarrh may be set up, or multiple foci of suppuration in the substance of the kidney may be provoked and a true pyelonephritis is the result. These small abscesses may amalgamate and form large cortical or medullary abscesses and burst into the pelvis. The general symptoms are very grave; severe rigors, high fever, and lumbar pain being among the most marked. The urine is scanty, albuminous, and purulent.

Chronic Pyelitis.—This usually presents three stages, onset symptoms, formation of tumor, and stinking decomposition of its contents.

Onset Symptoms.—The onset symptoms vary greatly. In some cases there is no pain until long after pus is noticed in the urine. Usually, however, there is an aching in one loin or the back, a depressing sense of weakness in the lumbar region, which the patient cannot account for, or which may be connected with a blow on the loin. Not infrequently a marked polyuria is present. If the pyelitis is caused by a round stone which occasionally drops on the mouth of the ureter, or by some other form of ureteric obstruction, intermittent colics are suffered from. Hæmaturia, vesical irritability, and vesical colic are often coincident symptoms.*

Enlargement of Kidney, or Formation of a Tumor (Pyonephrosis).—I believe the kidneys are more or less swollen in most cases of primary pyelitis, the enlargement varying according to the distention of the pelvis or the calyces. Even in cases of calculi in which the ureters are permanently patent and the upper tract is well drained, the kidney itself is enlarged and the surrounding fatty tissue matted with inflammatory products which add to the apparent bulk of the organ. The appreciation of the actual size of the tumor differs, of course, with the rigidity and adiposity of the abdominal wall.

Decomposition of Residual Pyelitic Urine.—Sooner or later, if the case progresses and is not of a tubercular type, the fluid contents of the kidney or its pelvis become fouled from the adjoining colon or by vesical sepsis, introduced by the surgeon, ascending to the kidney. The laudable pus which, prior to this, separated rapidly from the acid urine now becomes transformed into a thick, solid muco-pus, very similar to, but probably more offensively fæcal in its odor than, the ammoniacal filth which is passed by patients suffering from advanced vesical disease. Microscopically, although the secretion may still retain its acid character, large crystals of the triple phosphates are present, their edges being eroded and nipped out by the acid tide which the healthy kidney pours into the bladder. Perhaps the cardinal symptoms of primary pyelitis are the discharge of acid pus in more or less abundance, the formation of a definite renal swelling which is tender on deep pressure, and the detection of fluctuation in the same if the collection is a large one. If a constant irritant is present, such as a stone, the tenderness is accentuated, and should the canal of the ureter draining a unilaterally distended kidney become

* The cystoscope points to the symptoms being produced by an exaggeration of the normal ureteric wave passing on to, and exciting, the bladder muscles. It is probably analogous to rectal tenesmus, which occurs in 35 per cent. of ileo-cæcal intussusception (Fitz).

temporarily obstructed from any cause, as is not unusual, the pus disappears for a time and the renal tumor and tenderness increase, but both diminish again as the pent-up pus suddenly escapes along the unchoked channel. In conjunction with these symptoms, there are those dependent on absorption, infection from the colon, or exhaustion: rigors, often quotidian (Roberts), fever of a hectic grade, loss of flesh, and diarrhœa. The most usual forms of chronic primary pyelitis are the calculous, the tubercular, and the traumatic, with or without ureteral obstructions. The reader must be referred to the article which deals fully with these diseases, but the following brief remarks on their salient features and the accompanying illustrative cases are not irrelevant or beyond the scope of this article.

Calculous Pyelitis.—The following case illustrates the gradual increase of a calculus in the renal pelvis, its irritation of the mucous membrane producing a symptomless pyuria, the gradual onset of perinephritic inflammation and adhesions, and the final decomposition of urine in the renal calyces. This train of changes occurred with renal swelling but without pelvic distention, because no marked obstruction to the corresponding ureter existed.

Pelvic Calculous Pyelitis of Twelve Years' Standing, Decomposition of Urine, very few Symptoms, Nephrectomy, Cure.—Twelve years ago the patient passed two pieces of stone from the right kidney, since which time he has always suffered a little pain in that organ of a dull character, sufficient to cause him to be aware that he had a kidney. He has not had hæmaturia since the beginning of the trouble. He applied for relief because his urine had been smelling foully for the last year, and he wet his bed at night. His urine was very fetid; its specific gravity was 1.020. Two per cent. of urea was present. The urine was murky, depositing a thick layer of pus, and a fine layer of blood. The right kidney was somewhat enlarged and tender. Over the anterior region of the kidney there was a definite muscular swelling, which disappeared when the patient was under an anæsthetic, and was supposed to be due to reflex irritation from the disease beneath. I removed the right kidney by the lumbar route, after considerable difficulty had been experienced from the very dense adhesions which were present. The entire pelvis was occupied by a large branched phosphatic stone, which had so irritated the kidney pelvis as to produce perinephric matting. The kidney was riddled with small walnut-sized cavities, containing pus and urine. The patient recovered promptly and the nocturnal enuresis disappeared.

Calculous Pyonephrosis.—It is remarkable how tolerant the distended and inflamed pelvis of the kidney proves itself to be. Large stones are carried almost without any symptom pointing to resentment of their presence. This is especially noticeable in the female kidney.

Hæmaturia is very seldom observed when pyuria is marked, and rarely is there any complaint of pain, beyond a dull kidney-ache. When, however, an acute pyelitis is grafted on a chronic form, the suffering may be of an extreme character. Women seem particularly prone to the formation of calculi in a distended renal pelvis.* The calculus in such cases may be, and I suspect often is, the result and not the cause of the distention. The latter may be due to intermittent uterine tugs, and other forms of uterine pressure, *e.g.*, pregnancy, causing first a latent hydronephrosis, and secondarily a pyonephrosis. It will be found that 75 per cent. of cases of calculous pyonephrosis operated upon were females, and that nearly all these had a well-developed renal tumor.

Mr. Day [30] has removed a large right renal stone, weighing 1,331 grains, from a woman, age thirty-two. The symptoms had existed fourteen years, and they consisted in occasional pain in the right loin, lasting perhaps three days, with intervals of complete freedom. Apparently a right renal tumor had been noticed only a year, and coincidently with its appearance was the change of the urine to a thick, slimy condition. The right lumbar incision was made, and the stone, which was mainly phosphatic, was successfully removed in two sittings. Probably this is one of the largest calculi removed from the kidney.

Mr. Bloxam recently showed a soup-plate full of large calculi (13 ounces) which were removed by him through a lumbar incision from a woman who presented few symptoms of the disease.[31]

Tubercular Pyelitis.—Usually primary tubercular pyelitis is a true tubercular pyelonephritis, for it is rare for the pelvis to be affected without the renal tissue becoming rapidly implicated, and *vice versa*.

Cases have been mentioned in the section on Hæmaturia (tubercular disease of the kidney). Judging by Brodeur's statistics, it would seem that women were more often affected by this disease than men. This, however, is not so. I believe women present tubercular renal tumors more frequently than men on account of the greater chance of pressure on the lower ureters, but most of my renal tubercular cases have occurred in males. I believe that a large number of the cases of suppurative pyelonephritis occur in patients with tubercular tendencies, and in these a slight accident or subacute ascending pyelitis is sufficient to cause rapid destruction of renal tissue of weakened resistance. The pyelitis of primary renal tuberculosis may

* Calculous pyelonephritis, 49 females, 17 males; suppurative non-tubercular pyelonephritis, 29 females, 14 males (Brodeur).

remain subacute for some months, being merely accompanied by intermittent attacks of slight pyrexia and pain. The urine is acid, low in specific gravity, and murky with pus, and contains albumin in excess of what can be accounted for by the pus present. Even at this stage rabbits can be successfully inoculated with it, but the bacillus is difficult to discover, unless the tuberculosis is very acute. The kidney is invariably tender, but unless it has been aggravated into resentment by vesical washing, it does not rapidly enlarge. Given, however, a septic condition of the bladder, pus rapidly increases, the kidney enlarges, and often perinephritis is superadded.

Traumatic Pyelitis.—Pus appears for a short time after any blow upon the kidney of force sufficient to produce hæmaturia, and will continue in direct proportion to the extent of the injury. Usually, however, if the lower urinary tract does not become seriously inflamed the pus will disappear as health is regained. Some cases of traumatic renal pyuria prove extremely obstinate, and in these it may be that a calculus has formed or a marked tubercular inheritance or infection causes a sluggish healing of the renal wound. Occasionally a perinephritis is first produced by the blow and the collection of pus bursts into the pelvis of the kidney. This is, I believe, rare. I have recently performed nephrectomy for a pyelitis following a blow.

A young man, aged 24, whose father and brother were reported as having died of phthisis, presented himself with a large pyonephrosis, which was visibly occupying the left side of abdomen. On December 26th, 1892, he was struck violently in the left loin, and he attributes the cause of the present swelling to the blow. He did not pass blood and he never noticed his water murky until recently, when its very offensive smell and thickness prompted him to seek relief. The urine was turbid and very fetid, it was acid in reaction, specific gravity 1.019, and contained albumin and one-third pus. On my seeing him a day or two after admission, he was just beginning to suffer from pain in the loin, and I was struck with the coincidence of rapid enlargement of the tumor and decomposition of the urine with normal temperature. No vesical or urethral intervention had been attempted. I learned that he had had an obstinate attack of profuse diarrhœa three weeks ago, which may have been the consequence or the cause of the fetid character of the pyonephrosis. Until the tumor appeared he could retain his water for five or six hours, but since then he had been forced to micturate every hour; he did not rise at night. On performing lumbar nephrotomy, I evacuated eighty ounces of the most nauseous puriform urine from a superficial renal sac and found another large cyst deeper, which I tore into by means of a large probe. A still deeper though smaller collection was found. I therefore slipped the kidney out of its capsule, tied off the pedicle and removed it. There was no stone; the entire kidney had been transformed into an enormous loculated thin-walled sac. The ureter

which was not dilated was tied off, and dropped back. The urine cleared immediately, it was passed at a long intervals, and the wound rapidly healed.

Secondary Pyelitis.—Probably the most usual cause for pyelitis lies in an upward extension, along the ureters, of the inflammation which has originated in the bladder, prostate, or urethra, and it is in these cases that the diagnosis of pyelitis is so difficult and uncertain. It is often impossible to state with certainty how much of the pus is contributed by the original disease, and how much by that grafted on to the secondary extension. It is, therefore, in this class that so many mistakes are unwittingly made, and attention and treatment are directed to the bladder ailment long after that viscus has become a subsidiary factor as a pus producer. The cystoscope, in the hands of skilled workers, certainly enables a correct diagnosis to be made, but in general practice the cystoscope is impractical, and clinical grounds are all that can be depended on. These are frequently unsatisfactory and misleading. The ureter, pelvis, and kidney may become affected from the bladder either rapidly or slowly.

Rapid Invasion of the Renal Pelvis from a Bladder Source.—A rapid invasion of the renal pelvis is comparatively uncommon, and fortunately so, for it is often fatal. Usually the extension is slow in progress. Probably the rapidity greatly depends, in non-tubercular cases, on the previous health of the ureters and kidneys, prolonged lithiasis acting as an injurious depressor to the power of resistance of these organs to septic invasion. The barrier which the tonic muscles of the ureter oppose to ascending changes is an important factor in resisting invasion, for if the ureters have become dilated by backward pressure, and the mucous membrane is proportionately thinned, the septic wave may ascend in a few hours and a fatal result ensue. The most marked and the most frequent examples of rapid invasion are to be found in consequence of injudicious instrumentation, in vesico-prostatic tuberculosis, in uratic stones in gouty patients over fifty, and in the advanced vesical atony of prostatic enlargement. It is rare that gonorrhœal extension to the kidney is of the rapid type, but I have met with a few instances of undoubted chronic invasion. The features and dangers of this class may be briefly illustrated by the following cases and remarks.

Rapid Pelvic Invasion from a Tubercular Vesical Source.—The presence of a secondary tubercular pyelitis can only be expressed by the suppurative destruction it causes in the kidney. The latter is probably affected previously, though latently, by the lymphatics along the ureter. The septic invasion is merely a spark to ready tinder. Vesical tuberculosis, however, differs in its resentment to instrumenta-

tion according to the sex of the patient, and the stage of the disease in which instrumentation is commenced. The tubercular bladder of a female patient may be lightly sounded and even washed out with comparative impunity in the first few months of the onset of the disease, and this without much risk being incurred. There comes, however, a time unmarked by danger signals, in which washing is fatal to the integrity of the kidney, though the sound may still be used without this untoward result. Still later the sound is dangerous. In the male the sound is as dangerous as the catheter and washing, in all cases where the prostate is nodular and the bladder is inflamed. Either instrument is sooner contra-indicated than in the female. The actual invasion is usually along one ureter, and differs from the other ascending forms to be immediately described, in that one kidney only suffers and that by a localized abscess. I account for this on the supposition that one ureter always suffers more in backward pressure, in stricture, enlarged prostate, and other urethral obstruction. It is probable that the kidneys rarely work equally well, and that the ureters have differing muscular, arterial, and nervous health. Later still where both kidneys have been crippled, and the ureters are involved, the mere introduction of a bougie through the prostatic urethra is sufficient to cause rapid and fatal suppression. I regret that I can furnish many examples, but the following will suffice:

Left Renal Tuberculosis, Instrumentation, Acute Pyelitis, Renal Abscess, Nephrotomy.—I saw in consultation a patient, who had applied a few days previously to a well-known surgeon for the relief of a frequency of micturition and of a dull fixed pain in the left kidney. The irritability of the bladder was not excessive, and the urine was quite clear, so he was sounded for stone in the consulting-room. Two hours afterward his temperature suddenly rose without a rigor, the dull pain in the left loin increased in severity, and the urine passed was slightly murky. The temperature remained above 102° and he began to lose ground rapidly. The left kidney was slightly enlarged and intensely sensitive to pressure. The urine contained pus to a small amount; it was acid, pale, specific gravity 1.010. On inquiry I learnt there was a family history of diabetes, and that three of his immediate relatives had died of phthisis. Nephrotomy was performed. The surface of the kidney was seen to be of a mottled yellow, and a quantity of pus and white flaky caseous material was evacuated from the cortex of the kidney. Obviously a tubercular deposit had broken down under the influence of an ascending pyelitis. He was temporarily relieved.

Ascending Pyelitis due to Instrumentation in Gouty Kidneys.—It is known that kidneys which habitually cast off uratic deposits become less effective as time goes on, and less able to withstand sudden reflex shocks and inflammatory invasions, but the caustic effect which

a constant stream of uric acid, or of its salts, produces upon the urinary mucous membrane is hardly appreciated by the profession. This is probably because the parts upon which most of our pathological knowledge is based are examined after death when congestion has disappeared, and all granulation of surface has become invisible from post-mortem change. It is quickly realized, however, if the bladders of those passing uric acid are examined with the cystoscope. The vesical neighborhood of the ureter is reddened, the surface is blurred, and often granular. It is highly probable that these conducting channels are affected in a similar way. It is abundantly proved that such changes in the urethra predispose, on the slight provocation of an error in diet, of a chill, or the traumatism of a connection, to the production of urethritis. The entire urinary tract of a patient who has been voiding uratic urine for years is nothing more than surgical tinder.

Let a typically gouty man, over fifty years of age, with clear sterile urine, suddenly get a small renal calculus trapped behind a large prostate, and he is frequently in more danger from the action of a rough, unskilful surgeon than from his stone. After litholapaxy the temperature rises, pus appears in the urine from cystitis, ascending pyelitis supervenes, and the patient may even succumb from renal suppuration.

Acute Ascending Pyelitis Following the Removal of Large Amounts of Urine in Prostatic Enlargement.—Instead of laboring to excrete salts as in the previous disease the renal tissue may become so impoverished by unsuspected backward pressure from an enlarged prostate that water only filters through. A patient about sixty years of age may be a martyr to aggravated dyspepsia and increasing weakness, the excretory needs of the body being barely maintained by the insufficient renal function. Suddenly the medical attendant discovers the bladder well above the umbilicus, and disregarding the three great danger signals which accompany the pus in the urine—morning vomiting, intense thirst, abundant urine of a low specific gravity—he passes an instrument and withdraws all or most of the urine. At once the mild cystitis is aggravated, or if it was not present before it now appears, acute ascending pyelitis ensues, and renal syncope supervenes in from seven to ten days.

Chronic Invasion of the Renal Pelvis from a Lower Source.—Usually the method of invasion of ascending pyelitis is chronic and progressive, the pathway being prepared by more or less dilatation of the ureter or ureters by backward pressure. It might almost be asserted that chronic ascending pyelitis is a late stage of, often a sequel to, most chronic diseases of the urinary tract, and that it is present in

direct proportion to the duration and severity of the vesico-urethral obstruction.

Especial attention may be directed to two diseases which are most prone to affect the ureters although no previous distention of their channels have occurred. These are cystitis in the female, following pregnancy, and tubercular disease of the lower urinary tract.

Pyuria of Vesical Origin.—All the diseases of the bladder provoke the appearance of pus, either in an early or in a later stage; the character of the discharge is of no diagnostic value, though much can be gathered concerning the grade of the inflammation, and the depth to which it has penetrated the vesical wall, from its aspect and smell. Thus, very slight amounts of pus in acid urine, with vesical symptoms, denote localized surface changes such as are seen in early tuberculosis, or in the cystitis of the female bladder of uterine or ovarian origin. The thick, ropy pus which is alkaline, and ammoniacal in smell, denotes a more chronic form in which there is some general and deeper penetration, and some constant source of irritation, such as a calculus or decomposing residual urine. When the entire thickness of the wall has been implicated (parenchymatous cystitis), the feculent odor denotes the transmigration of micro-organisms and their products from the adjoining gut. The age of the patient in whose urine vesical pus appears affords some clue to the origin of the pus. It is rare in childhood, unless stone is present. Between puberty and adult life, if gonorrhœa is excluded, it is generally due to tubercular affection. Between twenty and thirty most of the so-called inflammations of the bladder are really cases of posterior urethritis of gonorrhœal origin involving the bladder neck. In women between twenty and thirty-five the pressure and inflammatory troubles of pregnancy account for many of the inflammations to which the female bladder is liable, and the obstinate character of the disorder would be incomprehensible were it not realized that the original focus of an inflammation remains unabated in the shape of some chronic uterine mischief. In mid-adult life the cystitis of stricture and sometimes that of spinal atonies are encountered, but usually the most fruitful cause of pyuria commencing at or about the age of fifty, is found in the changes to which the prostate is liable, and in the many secondary inflammatory conditions which it induces.

Pyuria of Urethral Origin.—In the strict sense of the term, urethral pyuria merely relates to inflammatory conditions arising behind the compressor urethræ, for pus arising from diseases of the penile urethra issues independently of micturition, since there is no muscle in the urethra between the compressor and the meatus to check the free exit of the discharge. Inflammation of the posterior (deep)

urethra is usually accompanied by irritability of the bladder and usually by some sense of obstruction to the stream. The three-glass test serves, however, to divorce it from an inflammation of that viscus.

Treatment of Pyuria.

Stimson wisely draws attention to the necessity of preventing pyelitis, and this is possible to a considerable extent in those classes which furnish the largest number of cases—the calculous and ascending forms. For prevention of the former the reader is referred to the article on stone in the kidney, and I have attempted, both in this section and in that on hæmaturia, to emphasize the amount of damage surgery can do to the renal functions by rough and injudicious action in treating diseases of the lower urinary tract. I am convinced that much of the destruction caused by the ascending form of pyelitis might be prevented, for it is not only those patients that die rapidly from renal suppression after instrumental interference, who are the sole victims. Many leave our care with more or less crippled kidneys, and though they are regarded and recorded as cures, yet some intercurrent disease or some subsequent chance congestion accentuates, or renders irreparable, the renal damage which might in the first instance have been avoided. The subject will be attended to in the various sections on treatment, but, as a general rule, no operation on the lower urinary tract should be undertaken unless the patient has rested for some time previously in bed, or unless the urinary passages have been disinfected as far as possible by the internal exhibition of drugs, such as boric acid and benzoate of soda, salol, naphthol, diuretin or what appears to be its equivalent, sodio-salicylate of theobromine, in ten-grain doses every four hours (Stimson).

The treatment of pyuria is so intimately linked with its causation that those forms which are more commonly encountered must be considered separately, and this mainly under the head of Instrumental Interference. For there are few cases of confirmed pyuria, if we except tuberculosis, which may not be benefited by surgical aid.

General Treatment.—If the pus appears as the result of a simple catarrh, it will probably subside after rest in bed, and the free exhibition of bland diluents, to which some form of alkali is added, hot fomentations being applied and opium given if necessary. If the pus is small in amount, but constant, and is not developed during some acute infectious fever, it may be subdued by boric acid and sodium benzoate, this mixture being especially useful when the urine shows phosphatic tendencies. The chronic pyelitis of gouty people is greatly benefited by a course of Contrexeville or Wildungen water.

Failing this, the balsams in small doses are valuable—santal oil, copaiba oil, and turpentine.

To subdue the pus in ordinary pyelitis, nitro-muriatic acid and quinine; alum, or tannic acid in two-grain doses, if much mucus is present; iron in large doses;* acetate of lead, three grains, cautiously increased, three times a day—are strongly recommended. When polyuria in pyelitis is marked, Morris recommends half-drachm doses of liquid extract of ergot. If the urine is fetid, creasote may be tried (Dickinson). A liberal diet, a change of air, preferably to the sea, when the pus is of pyelitic origin and passed in large quantities, is often of the greatest value.

Acute Primary Pyelitis and Pyelonephritis.—Little can be done by the surgeon in acute forms of primary inflammation of the kidneys and pelvis, for usually the disease is bilateral, and the changes are too extensive and too rapid to be amenable to operation.

Chronic Pyelitis and Pyelonephritis.—When the disease is unilateral and a fair percentage of urea is found in the urine, demonstrating the working power of the other kidney, the surgeon may interfere with a reasonable chance of success. In calculous pyelitis, after medical treatment has been fairly tried, no time should be lost in clearing out the pelvis by the lumbar route. Each year adds to the dangers of pronounced calculous pyelitis and to the difficulty of removing the calculus without damage to the future working capacity and stress resistance of the kidney. Moreover Turner's[23] post-mortem statistics, which represent the condition of calculous kidneys which have run their course, are pregnant with the lesson of early interference. Of forty-three cases of renal calculi described in the post-mortem records of St. George's Hospital for the past twenty-one years, pyonephrosis was present in twelve cases. In nine the ureter was completely blocked, and in eight of these the obstruction was at the renal end. With regard to the condition of the unaffected kidney in those cases in which only one side was calculous, it was granular and cystic in nine, lardaceous in two. There remained only eight cases in which the other kidney was either healthy or hypertrophied.

Concerning this operation only the following remarks need be added: When the calculous pyelitis has been in existence for some time, the surroundings of the kidney will be found very densely matted and adherent, and in some cases they will resemble the gelatinous surroundings of advanced tuberculosis of the kidney. Although the stone may be removed a permanent sinus may be left,

* It must be remembered that small doses of iron not infrequently aggravate a pyuria.

and to avoid this the surgeon must decide whether nephrectomy ought not to be done, the stress resistance of the opposite kidney having been previously ascertained.*

In calculous pyonephrosis the operation, consisting merely in clearing away the calculi and washing out the sac, is easy, but the resulting shock is often severe and this apparently in proportion to the size of the tumor. In some instances the patient has died suddenly a few hours after the operation. It may be that the cardiac muscle had become affected by absorption from the puriform sac, for shock does not follow the removal of large amounts of urine from hydronephrotic sacs. When perinephritis has ensued on perforating pyelitis, it will be better in most cases to remove the kidney at the same time that the perinephritic collection is evacuated; or, if the sac is so enormous that the kidney has been pressed out of reach, then nephrectomy had better be postponed for a week, after which time the kidney will have regained its normal position.

Probably Dickinson" has since seen fit to alter the following cautious opinion which he expressed in 1885: "Where pyelitis is conjoined with obstruction of the outlet and has led to so much accumulation of pus as to cause bulging in the loin, the question of puncture or incision may be entertained, but I think it is generally safest to wait until the matter has worked through its renal investment and presented in the back, and even then until it is nearly subcutaneous, rather than to seek for it deeply."

Primary Tubercular Pyelitis.—The only reasonable chance of success in this disease is the early removal of the diseased kidney and as much of the ureter as is possible. Nephrotomy has not proved of much assistance, although the incision through the capsule has relieved the intense pain that is often suffered in the renal region. Also by diverting the tide of acrid pyelitic urine through the loin the irritability and frequency of micturition are allayed. Merely scooping out scrofulous deposits and stuffing the cavity of the abscess with iodoform gauze is rarely curative, for many other deposits in the parenchyma usually coexist, and these, if they are overlooked, become infected and the temperature does not drop. Besides, the ureter is imperfectly drained, and the disease progresses more rapidly because septic changes have been set in action by the exploration.

Ascending Pyelitis.—The great secret of the prevention of ascending pyelitis rests in asepticism, extreme gentleness, and free bladder drainage. This is especially the case when the deep urethra is resent-

* I hold very strongly that no interference with the kidney should be undertaken unless permission has been given, and preparations have been made, to remove the organ if it be found wise to do so after examination.

ful, as in the case of gouty and onanitic prostates. Probably the reason why Frère Come was so successful in suprapubic cystotomy was because of the perineal drainage he invariably employed. Much of the ascending pyelitis now grafted by surgery on a diseased and dilated ureter might probably be avoided by bladder drainage through a small perineal wound. This is especially indicated in calculous affections of the bladder in old age, the stone being the result and not the cause of the chronic cystitis. The ascending form of pyelitis is often distinctly improved by bladder drainage, a subject to which Mr. Harrison and Professor Guyon[84] have lately drawn special attention. The latter authority, in a clinical lecture based upon two cases of women with simultaneous pain in the bladder and kidneys, has emphasized the value of drainage. One patient passed urine full of pus, the kidneys were large and painful, and she suffered from agonizing attacks of vesical spasm. There was also feverishness with dry tongue and dyspepsia. M. Guyon concluded that the origin of the trouble lay in the bladder, and that it was not advisable to operate on the kidney at once. The bladder was therefore laid open from the vagina, and kept open. The vesical pains at once ceased and the spasms never returned. The condition of the kidneys slowly improved, and the pain disappeared; they ultimately diminished in size and ceased to be palpable on manual exploration.

M. Guyon bases treatment of this kind on careful examination of the bladder. When, as in this case, the sound causes severe pain when it touches the mucous membrane, when the bladder is tender on pressure of the hand over the pubes, or of the forefinger against the anterior vaginal wall, the primary lesion will be in the bladder, and the renal swelling and pain will be secondary. Let the bladder rest then, and the kidney will empty itself, and this will cause subsidence of the pathological changes in the renal pelvis and glandular tissue. All such cases do not demand such active treatment as cystotomy. Simple medical treatment of cystitis, rest and weak antiseptic injections may be sufficient if taken in time. On the other hand, Bozeman's treatment of pyonephrosis by the establishment of a vesico-vaginal fistula, and subsequent catheterization of the ureters, cures the renal complication on the same principle, but the practice is only to be undertaken by experts.

M. Guyon's second patient was in an earlier stage of treatment when his lecture was delivered, but the vesical pain, fever, and dry tongue had disappeared. In a neighboring ward lay a man who had entered with retention and infiltration of urine from giving way of the urethra; at the same time a large pyonephrosis of the right kidney was detected. The infiltration and retention were treated in the

usual manner. Within two months all the physical signs of pyonephrosis had completely disappeared. "To run to the assistance of the kidneys by methodical treatment of the lower part of the urinary tract should be a fundamental law of surgery."

But drainage does not always succeed. Thus, in one case of severe unilateral pyelitis the result of backward pressure from an enlarged median prostatic lobe, I first removed the lobe suprapubically and the bladder was then drained for more than two months, but the formation of pus did not subside. After a year, although the stream was full and free and the residual urine only amounted to an ounce, the amount of pyelitic pus was still one-third. I therefore incised the kidney and evacuated an abscess from the deep part of the cortex and drained the pelvis. The urine at once became crystal clear and remained so for some days, until the renal drain was left out, after which it relapsed, but never reached again the same severe grade. Prolonged renal drainage in these cases does not mean for a few weeks, it is a question of months, and the struggle lies in preventing the wound in the integuments from closing. One mistake will occasionally be made, namely, that of preserving hopelessly damaged kidneys. The drain-wound heals and the abscess recurs. This may be indefinitely repeated unless the patient suddenly develops acute septic infection.

Vesical Pyuria.—The treatment of suppuration from the bladder consists in first removing the cause of any permanent irritant, such as stone, stricture, or enlargement of the prostate, which may be discovered, and for the management of which the reader is referred to the article on such diseases. Should any such irritant be absent, the various methods of treating cystitis must be employed.

The treatment of the acute form must be carried out regardless of the cause, for in all operative work about the bladder, inflammation must be first subdued before any instrumental interference is commenced. In the acute stage there are three powerful agents in reducing the severity of the attack, viz., 1. Rest in bed with elevated hips; 2. Free imbibition of diluents; 3. Anodynes administered by the bowel. The elevation of the hips withdraws from the bladder the pressure of the intestines. The diluents render the urine copious and as non-irritating as possible. Those which are the most reliable are "teas," made of linseed, buchu, or triticum repens. Those who can obtain it fresh and good can rely upon the liquid extract of Collinsonia Canadensis (ɱ|xx.), or the extractum stigmatum maidis. They are often invaluable. Taken separately or in combination with these should be a sufficient amount of alkali to render the urine less irritating. Citrate of potash or liquor potassæ are the most useful.

Anodynes act best by the bowel. A suppository of watery extract of opium, gr. ss., or of morphine, gr. ¼–½, combined with extract of belladonna, gr. ss–i., is the most serviceable. In addition to these remedies a hot hip-bath from 100° to 105° should be given for a quarter of an hour two or three times daily, and hot applications made to the perineum and pubes either by Leiter's coils, hot flannels, spongio-piline, or poultices frequently changed. Hot rectal enemata twice or thrice a day are most soothing, besides being of value in keeping the lower bowel clear. Laxatives and a fluid diet complete this plan of treatment. In subacute cystitis the balsams are of use—sandalwood, copaiba, turpentine. In chronic cases, if the source of the trouble has been removed, vesical irrigation must be employed, but with this reservation, that if signs of tubercular deposit in any part of the body are discovered the use of the catheter must be sedulously avoided. The injections which will be found the most serviceable are boro-glyceride solution; iodoform emulsion (five grains suspended in an ounce of mucilage and water), left in the bladder after it has been thoroughly cleansed by weak solution of permanganate of potash; salicylic acid (one-half per cent.) cautiously increased, and finally a solution of mercury perchloride of the strength of 1 in 10,000.

The cure of cystic pyuria in the female depends greatly on the cure of the metritis, perimetritis, ovaritis, or uterine displacement which frequently accompanies and often has been the cause of the complaint. Much stress, and deservedly, has been placed upon resting the female bladder in the aggravated forms of cystitis when drugs and injections have failed. This is accomplished by dilating the urethra or by making a buttonhole fistula in the base through the vaginal roof. Dr. More Madden has found that marked relief is obtained by forcible dilatation of the urethra and the induction by this means of temporary incontinence of urine, accompanied by the free application of glycerin of carbolic acid to the mucous membrane. Two or three applications at intervals of ten days may be required.

Urethral Pyuria.—The treatment mainly consists in quieting the cystitis of the neck of the bladder which coexists to a greater or lesser extent in every case; in removing any permanent cause of obstruction, such as stricture, or any direct irritation such as a prostatic calculus. Subsequent injections in the deep urethra may be made by means of either Guyon's or Ultzmann's syringe. With the former, five or ten drops of a solution of nitrate of silver in strength varying from five to twenty grains to the ounce are thrown directly into the membrano-prostatic urethra. Ultzmann recommends most strongly the irrigation of the neck of the bladder as well, and this

is carried out by throwing into the deep urethra eight ounces of the nitrate of silver solution of a strength of one grain to eight ounces. This enters the bladder slowly, and after being held for a few minutes is expelled by the patient voluntarily.

Prognosis of Pyuria.

As some stress has been laid upon the necessity of operative interference in the treatment of obstinate and aggravated pyuria, it is but right that the prognosis of the untreated forms should be touched upon. There is no doubt but that cases of pyelitis have resulted in a spontaneous cure. Moreover, on the post-mortem tables small atrophic kidneys containing a cheesy material or the dried chalky remains of pus, or a large urinary calculus, have been frequently discovered, and the corresponding ureters have been found thickened and contracted. This fortunate termination cannot, however, be reckoned upon, and it is noteworthy that many of these cases had had no history of symptoms referable to the disease. Hence probably no accentuation of their condition, by the well-meant but mischievous exploration of the bladder, had been undertaken. The gravity of pyelitis is in direct relation to its cause. I believe I have seen undoubted cases of tubercular pyelitis recover, temporarily at least, under favorable dietetic and hygienic conditions, and I have met with unquestionable cases of vesical and prostatic tuberculosis which have been in abeyance for as many as twenty years. This, however, is the exception, and most cases of this kind end fatally. The calculous form of pyelitis without pyonephrosis is perhaps the most favorable disease of all. As a rule definite pyonephrotic tumors, unless relieved by art or unless they discharge themselves through the loin, are undoubtedly fatal in the end. Of the ascending chronic forms of pyelitis, that which follows pregnancy may be considered as being the most favorable. Probably the great improvement which now obtains in the treatment of vesical stone, enlarged prostate, and stricture, will improve the prognosis of pyelitic complications of these disorders. These have hitherto being considered as extremely grave. One remark only need be made: A patient with a pyelitis or a slight pyonephrosis may continue well, or apparently well, for years. Suddenly, without any previous warning or appreciable cause, a change for the worse occurs. Rigors, high temperature, vomiting, thirst, extreme pain in the side or back, and prostration, mark the sudden general absorption of pyogenic poisons from a sac which has for long intervals been quiescent. Often the patient is beyond hope even when an operation is immediately undertaken.

ACCIDENTAL ALBUMINURIA.

It has long been accepted that the mere presence of albumin in the urine in small quantities does not necessarily indicate the presence of organic disease of the kidneys. When traces of albumin are present and no organic disease of the kidney can be discovered, the symptom is termed functional albuminuria. This subject still requires elucidation, although the literature is copious and recent. Senator, Leube, Posner, and others hold that traces of albumin may be found in the urine of healthy people (physiological albuminuria).

Many of the observations recorded, however, lack the imprint of accurate research for determining the presence of serum albumin as distinct from that which is said to characterize cardiac and amyloid kidney (Semmola), osteomalacia, and other diseases. There is no doubt, however, that some of the cases which are considered to be albuminuric are examples of mistaken diagnosis, due to inaccurate examination. Thus Malfatti [28] mistook mucin for serum albumin. In some, traces of blood or pus have been overlooked, in others an obstruction to the free outlet of urine from the ureter or bladder has remained undiscovered, and the albumin detected in the urine is serum due to strangury or spasm. Lastly some of the young men, in whom a diagnosis of albuminuria is made, are passing seminal or prostatic fluid in their urine, and in such cases it is well known that a trace of albumin is found. In this article we shall treat of those cases in which albumin emanating from an extra-renal source becomes mixed with the urine, a condition known as accidental albuminuria.

Extra-Renal Albuminuria, or accidental albuminuria, is due to the presence of:

a. Pus.—The urine of gouty people not infrequently contains a slight admixture of pus arising from a mild catarrh due to the irritation, direct or indirect, of uric acid. The pus may come from any part of the collecting or conducting passages, and no symptoms are present to mark its origin or cause. Dietetic irregularities or exposure to cold, in feeble and delicate persons, especially in the middle-aged and elderly, says Ralfe, will often induce a catarrh of the mucous membrane, of sufficient intensity to lead to the formation of pus corpuscles. Virchow has recently related how in his own case, during an attack of gout, his urine became albuminous and on examination was found to contain pus, with an abundant deposit of uric-acid crystals.[29]

Perhaps, however, the larger number of mistakes are made in deal-

ing with patients who are suffering from a symptomless deep gleet and its effects.

The following is an excellent example:

An officer of the English army was offered an important African governorship, but found himself debarred from accepting it by a medical report that he was suffering from albuminuria. He had seen active and arduous service in Afghanistan, and it was supposed that the cold to which he had been exposed had induced nephritis. On examination I found a simple valve nearly occluding the deep urethra, and his urine contained a microscopic amount of pus. Dilatation of the stricture, and a few applications of nitrate of silver to the serum-sweating surface behind it, was all that was required to remove the fancied albuminuria, and to procure his appointment.

I could record several other and similar examples, but the following, which illustrates an analogous condition of the ureter, is too emphatic to be omitted:

A patient aged fifty-six was brought to me to determine the cause of an intermittent hæmaturia, which had been noticed for some years. A very distinguished physician had examined the patient several times before, and had analyzed the urine. More than a marked trace of albumin had been found in clear urine, which was of low specific gravity, and casts had also been seen. A diagnosis of chronic Bright's disease had been, therefore, supplied to the practitioner in charge of the case. The cystoscope revealed a tough fibro-papilloma, spreading around and partly occluding the left ureteral orifice, the ejected contents of which tube were murky and contained pus and flakes. Obviously the throttling of the ureteral orifice had induced back-pressure changes and mild ascending pyelitis. Urine from the other kidney showed an ordinary specific gravity (1.025); it was acid, clear, and contained 2.5 per cent. of urea. Thus the discharge from the pelvis of one ureter was incautiously inferred to represent the secretions from both kidneys.

b. Blood.—A small quantity, even a microscopic trace, means a corresponding amount of serum albumin. It is likely that some at least of those cases, diagnosed to have albumin in the urine from exertion, may have had latent renal calculus or some other cause for the appearance of a microscopic quantity of blood which would show, on testing, a trace of albumin. It is, I believe, especially in the latent periods of villous papilloma or other forms of vesical growth that serum albumin and small quantities of blood appear. This often happens before the attack of hæmaturia which first draws attention to the urinary tract. I have known several patients, from whom I have subsequently removed villous papillomata, to present themselves with a history that, in the earlier stages of the papilloma, a diagnosis of Bright's disease had been made.

The highest accentuation of this condition is found in the symptom known as "fibrinuria of Ultzmann," in which the urine gelatinizes after being passed. It is only seen in rare cases of villous papilloma, and it is due to the straining of the serum through the slender vessels of the fragile growth.

c. Serum Leakage.—The albuminuria of spasm or strangury is on a par with the preceding, although the character of the surface from which the albumin leaks is different. Usually the surface epithelium has been shed in various parts of the bladder, under the influence of a chronic inflammation, and the spasm set up by some form of obstruction, such as enlarged prostate, stone, or stricture, strains through the weakened wall a variable amount of serum. I believe that many patients are denied the benefit of operation by the discovery of more albumin in the urine than can be accounted for by the pus present. In the case of one patient on whom several attempts had been made to remove an enlarged median lobe by the perineal route, the surgeon became alarmed by the appearance of a quantity of albumin in the urine and refrained from operation. The patient came ultimately under my care. Not only were the kidneys intact, but he bore a very profuse hemorrhage from suprapubic prostatectomy, without any depression, and completely regained his health and bladder power, the albumin disappearing directly the vesical straining induced by the prostatic obstacle had been relieved. Serum leakage is also found in tubercular ulceration of the bladder, where there is spasm of the detrusor muscle. Perhaps this false albuminuria occurs more often in vesical calculus than is usually believed. In one instance I persistently refused to operate for stone on account of the decided amount of albumin in the urine, and yet this patient bore a suprapubic lithotomy for the removal of a five-ounce calculus without difficulty, and the water cleared subsequently.

d. Chyle.—The admixture of chyle also with the urine in chyluria causes the secretion to be albuminous. See section on Chyluria.

Seminal and Vesicular False Albuminuria.—It is stated that albumin is found in young males who are passing seminal or prostatic fluid. In these the microscope will reveal the characteristic appearances of the fluid, and if this can be established it is a significant fact that albumin is often found in boys attending large public schools where the tendency to onanism is great.

To avoid the mistake of diagnosing accidental as renal albuminuria it is but necessary to filter the urine, examine more carefully with the microscope, and take the percentage of urea.

CYSTINURIA.

The passage of the crystalline body, cystine (cystic oxide), in the urine constitutes the symptom known as cystinuria. Cystinuria is rarely encountered, only about seventy-five cases being recorded in the literature; its chief clinical interest centres in the formation of cystine gravel or stone.

Cystine, which is one of the rarer crystalline urinary deposits, was discovered by Wollaston in 1805, in a calculus composed chiefly of this substance. It has the empirical formula $C_6H_{12}N_2S_2O_4$, but the researches of Baumann leave no doubt that cystine is a dithio-amido-ethylidene-lactic acid, which may be represented by the subjoined formula (Gamgee):

$$S_2 \begin{matrix} /C\ (CH_3)\ (NH_2)\ COOH \\ \backslash C\ (CH_3)\ (NH_2)\ COOH \end{matrix}$$

It occurs in normal urine in minute quantities and when in excess it is precipitated in the form of a whitish or pale fawn-colored deposit, very similar in appearance to the pale urate of ammonia. Microscopically this precipitate is composed of six-sided tablets which are very characteristic. These plates are instantly dissolved by the addition of ammonia, but crystallize out again without change of form as the ammonia evaporates. Cystine is soluble in ammonia and the mineral acids, but not in acetic or tartaric acid; it is insoluble in carbonate of ammonia, water, and alcohol. Heated on platinum foil, the fumes are thick and white, and resemble garlic in smell. Cystine contains no less than 25.5 per cent. of sulphur.

The Character of Urine Containing Cystine.

The urine of a cystinuric patient is usually murky when passed, and is faintly acid or neutral. It has a yellow-green color, "honey yellow," and is said to exhale an odor, when fresh, resembling sweet-briar or sweet orris root, but it rapidly fouls from decomposition, and sulphuretted hydrogen is evolved, a greasy-looking scum forming on the surface. The carbonate of ammonia formed by the decomposition of the urea throws down a bulky deposit of cystine. Golding Bird noticed that the urine changes in decomposition from yellow to green, and in one case which he records it turned to a bright apple-green. It is stated by Niemann that urine containing cystine is deficient in uric acid, and Golding Bird asserts that urea is only present in very small quantities.

Tests.—The hexagonal plate-like crystals are characteristic, and

the surest test for cystine is recrystallization after the crystals have been dissolved in ammonia. The precipitate from cystinuric urine dissolves in potassic hydrate, and if a solution of acetate of lead be added and the mixture boiled, the black precipitate of lead sulphate will result (Liebig). But all sulphuretted animal matters similarly treated yield black precipitates; hence this test is useless if any portion of albuminous substances or bile be mixed with the deposit (Bird).

Roberts says that the ammoniacal solution of cystine generally deposits hexagonal plates or these mixed with a few prisms (*vide* Fig. 67). Sometimes, however, the prisms are more abundant than the plates. The prisms either lie singly or form stars. They refract light strongly, and the facets which lie slantingly out of the direct line of vision appear perfectly black, contrasting with the brilliant lustrous white of the planes through which the light passes vertically. This gives a peculiar striped appearance to the prisms, and causes them to appear deceptively six-sided. The hexagonal tablets have an iridescent mother-of-pearl lustre, their surfaces being often beautifully chased by lines of secondary crystallization; they also form thick rosettes of great brilliancy.

FIG. 67.—Cystine. Hexagonal tablets and prisms. (Roberts.)

Calculous Formation.—Cystine calculi, which cannot be said to possess any characteristic size or shape, are probably formed in the kidney pelvis, and descend into the bladder. They are usually smooth on the surface. They crush or break without crispness, and feel waxy in the grasp of the lithotrite, proving soft and compressible, and the fragments are evacuated by suction often with difficulty. The fractured surface is crystalline in appearance and of lemon-yellow color. The calculi are usually without lamination. Phosphates may form the coating of the calculus and uric acid the nucleus. When slightly burnt in a candle flame or rubbed on a handkerchief they emit an odor of garlic.

When the calculi are fresh their color is of a pale yellowish-

brown; they undergo, however, a remarkable change in course of time, turning slowly from brown to gray or green. Thus the calculus described by Dr. Marcet in 1817 was brown; now it exhibits a rich bluish-green color. This alteration is considered by some to be due to the changes produced by the sulphur. A similar change of color has been observed by Dr. Peter in two cystine calculi preserved in the Transylvania medical museum; the change commenced on that side of the concretion which was exposed to the light.

Causation.

The causation of cystinuria is still conjectural. From the fact that cystine contains sulphur and that it is very similar in its composition to taurin (Roberts), it has been considered that the symptom is a sign of hepatic derangement, and Prout, remarking "the peculiar tallowy and waxy character of the complexion," so frequently noticed in these cases, and finding fatty matter in the urine, suggested it was the outcome of fatty liver. Clinically it has been found often to coexist with disorders of the hepatic functions. Thus it has been found in the liver of typhoid patients, and is sometimes associated with jaundice and other symptoms of hepatic derangement. Virchow and Scherer have detected cystine in diseased livers.

Dr. Dickinson mentions the case of a doctor, who had habitually passed cystine crystals in the urine. The patient, when Dr. Dickinson saw him, had extreme ascites with evidence of obstruction of the portal vein, which his eventual recovery indicated as thrombotic. He had frequent bilious attacks. A second attack apparently of portal thrombosis, more severe than the first and attended with hæmatemesis profuse enough to endanger life, occurred twenty-four years after the commencement of cystinuria. During convalescence the cystine was observed to be unusually abundant. It was noted that bile was almost absent from the stools, the previous inactivity of the liver having been aggravated apparently by the sea air. No hereditary proclivity had been traced in this case.

Dr. Ralfe took the following view in 1885: "Cystine is formed directly from taurin, in a manner perhaps analogous to the formation of indigo from indol. The observations of Naunyn and Dragendorff have shown that normal urine contains traces of bile acids, of which glycocholic acid is the chief, so that it is probable that some portion of the taurocholic acid is oxidized, and furnishes the partially oxidized sulphur product, which in minute quantities is always in normal urine. Moreover, Dr. Oliver has recently shown, by means of his peptone test, that the bile acids are often enormously increased

in the urine in many morbid conditions, especially those connected with functional derangements of the liver and anæmia (Lancet, April and May, 1885). It may be, therefore, that under certain conditions the quantity of taurin eliminated by the kidney is increased, or its excretion checked, while the transformation into unoxidized sulphur is incompletely carried out, so the intermediate product cystine is the result."

Up to within a short time these various theories were accepted, but the recent researches into the intestinal ptomaines have thrown an unexpected and startling light upon the production of cystinuria, and although at present the views put forward cannot be accepted in their entirety, sufficient evidence is forthcoming to establish some casual relation between cystinuria and a form of intestinal mycosis of an infecting type.

Thus the researches of Stadthagen and Brieger, v. Udransky, and Baumann have shown that cystinuric urines contain diamines, and in particular putrescin, cadaverin, and a diamine which is isomeric with the latter (perhaps neuridin or saprin). These bodies occur at the same time in the fæces of such patients, while both urine and fæces of healthy persons are free from them. It is possible, therefore, that they originate in a special form of intestinal infection, and are absorbed from the alimentary canal and eliminated together with cystine in the urine.

Clinical Aspects.

But little can be said upon the clinical aspects of cystinuria. The substance has been known to have been passed intermittently in the urine for years without visible impairment of the bodily functions, but usually there are marked signs of deterioration of the general health, and the nutrition is bad. It has been noticed in tubercular, anæmic and chlorotic patients. The influence of debilitating agencies in increasing the deposit was most pronounced in Barry's case. Its most marked clinical aspect is the tendency which it exhibits to be hereditary. Golding Bird mentions a series of cases of cystine calculus appearing in three successive generations.

Dr. Marcet mentions two brothers who died with renal cystine calculus. Lenoir and Civiale extracted cystine calculi from the bladders of two brothers. Teale cut a boy for cystine stone and two of his brothers had cystinuria. Dr. Joel found cystine in a mother and two daughters. Poland says that out of twenty-two collected cases of cystine calculi ten occurred in four families, while in three cases the subjects were brothers.

Drs. Picchini and Conti relate the following case, which is given as an example of the many factors which may be at work in producing this metabolic modification:

The patient was a woman aged twenty-nine, who had good health until the age of nineteen, when she had acute rheumatism; at twenty-two she had another attack, accompanied by cardiac and pleural troubles from which she never subsequently became quite free. At twenty-nine she was attacked by subacute polyarthritis rheumatica, with joint deformities, pleural effusion, dry pericarditis, and general cardiac hypertrophy with mitral stenosis. She had also a febrile temperature, and her liver became considerably enlarged. The urine was scanty, 200 to 300 c.c., and showed a trace of albumin with hyaline casts and many leucocytes, also a trace of urobilin; the sediment contained abundant crystals of cystine. The bladder was found on sounding to be free from calculi. Her condition improved greatly during her stay in the hospital; the liver became reduced in size, the fever disappeared, also the urine became free from casts and albumin and increased in amount to about normal. The cystine, however, was never absent. The total amount of cystine varied with the quantity of urine passed and, contrary to what was noted in Ebstein's case, more of it was secreted in the day than at night. A nitrogenous diet made no difference, but milk increased the amount of cystine. Uric acid was increased during the day and lessened during the night, while urea was generally diminished.

Cystine calculi do not differ in their clinical characters from other forms. The following case which came under the care of my colleague, Mr. Heycock, is interesting as showing a gouty diathesis and as presenting the largest cystine calculus on record.

M. N., aged 50, was admitted into St. Peter's Hospital, London, with a history of calculous symptoms for the past nine months. He had been fairly well except for attacks of gout in the knees and hand, from which he had suffered twice a year during the last fifteen years. His bladder had been washed out and sounded by various medical men. The prostate was much enlarged, the urine showed a specific gravity of 1.015; it was acid, and contained a good deal of pus, albumin, and cystine. Median cystotomy was performed and the stone crushed with difficulty after Dolbeau's method. The fragments were soft and waxy, of a slight fawn color, and typically cystine in that they showed no concentric lines of increment. The weight proved to be two and one-quarter ounces. The patient recovered.

Treatment.

Unfortunately we have not advanced further in our methods of combating this disorder than we have in the exact knowledge of its pathology. The greatest benefit thus far obtained has resulted from

the employment of syrup of the iodide of iron, or of nitro-muriatic acid, combined with sea-bathing, exercise, and carefully regulated diet, so as not to place undue stress upon the function of the liver. As Golding Bird remarks, "We have an obstinate disease to treat, as are all ailments demonstrated to be hereditary. The prognosis must be extremely guarded on account of the tendency to form renal or vesical calculus." The recent work upon intestinal ptomaines suggests some correlation between cystinuria and diaminuria, and indicates the therapeutic employment of intestinal disinfectants. Mester has, however, tried thymol and alcohol as disinfectants without result.

PHOSPHATURIA.

The persistent and excessive elimination of alkaline and earthy phosphates in sterile urine constitutes the symptom known as phosphaturia.

Phosphaturia is often held to include two other and widely different conditions, viz., (1) those transitory deposits of earthy phosphates which occur in feebly acid or neutral urine; and (2) those deposits of the triple salt, the ammonio-magnesium phosphate, which are formed by the breaking up of the urea in catarrhal affections of the urinary tract, the resultant carbonate of ammonia combining with the magnesium phosphate in the urine to form a triple salt.

It is more logical and more accurate to classify the two latter conditions under the heads of "Functional Phosphaturia" and "Secondary Phosphaturia." For in both these classes the phosphates are in normal quantity, and are merely *en évidence* because of the alkaline reaction of the secretion. The following points will be considered here:

The excretion of the phosphoric acid and its salts by the urine.
The detection of phosphates.
The estimation of phosphatic acid.
Functional phosphaturia.
Secondary phosphaturia.
True phosphaturia.

The Excretion of Phosphoric Acid.

Phosphoric acid to the amount of from two to three grams is excreted in the urine in twenty-four hours. It is combined partly with sodium, potassium, and ammonium to form soluble phosphates, and partly with lime and magnesia to form salts, which, though soluble in the natural acid of the urine, are quickly thrown down when the

secretion becomes neutral or alkaline. The former group never forms urinary deposits, but the latter constitutes the earthy phosphates which are the chief features of phosphaturia and of advanced urinary concretions. It is unnecessary to make a separate estimation of these two groups, in order to gauge accurately an excessive elimination of phosphate. It is sufficient to estimate the amount of phosphoric acid.

The Earthy Phosphates.—Phosphoric acid is spontaneously deposited in the urine in one of the three following combinations (Roberts): 1. Amorphous phosphate of lime, or bone earth ($Ca_3(PO_4)_2$); 2. Crystallized phosphate of lime ($CaHPO_4+2Aq$); 3. The triple phosphate, ammonio-magnesium phosphate ($Mg\text{-}NH_4PO_4+6Aq$).

1. *Amorphous Phosphate of Lime.*—The occurrence of this deposit merely denotes that the urine has been rendered alkaline by a fixed alkali, as when the carbonates of potash and soda are present in excess. It forms an amorphous white flocculent deposit, which is increased by heat and dissolves rapidly in any acid. There is generally an iridescent film, "a gas tank" film on the surface. Microscopically, the deposit consists of minute granules aggregated into clumps.

It is chiefly found in patients who have taken large doses of alkalies. It is the normal deposit of alkaline urine, and its clinical significance and treatment depend on the cause of the alkalinity of the urine.

2. *Crystallized Phosphate of Lime, or Stellar Phosphates.*—The occurrence of a deposit of stellar phosphates is rare. Hassall first called attention to this form of urinary deposit in 1860, and Sir William Roberts, who re-examined the question in 1862, reported as follows:

The prevailing appearance is that of crystalline rods or needles, either lying loose or grouped in stars, rosettes, fans, or sheaf-like bundles (*vide* Fig. 68). Some of the crystals are club- or bottle-shaped and abundantly marked with lines of secondary crystallization.

The occurrence of a deposit of the stellar phosphate in urine is not common. It is, in fact, a rare deposit as compared with oxalate of lime, uric acid, or the triple phosphate.

The presence of this deposit in any quantity is, according to Sir W. Roberts, an accompaniment of some grave disorder. He has met with it in diabetes, cancer of the pylorus, once in phthisis, and more than once in patients exhausted by obstinate chronic rheumatism. The crystals may, however, under peculiar conditions, be precipitated in healthy urine. When the urine is rich in lime, and its

acidity is at the same time depressed to near the neutral line, stellæ of phosphate of lime may form quite independently of any grave disorder, merely as the result of a coincidence in the chemical composition and reaction of the urine; for example, if after a full meal the acidity of the urine becomes greatly reduced, and lime derived from the food is present in excessive proportion. Under such circumstances, I have several times detected stellæ of phosphate of lime, but only in small numbers. A depressed acidity of the urine is an es-

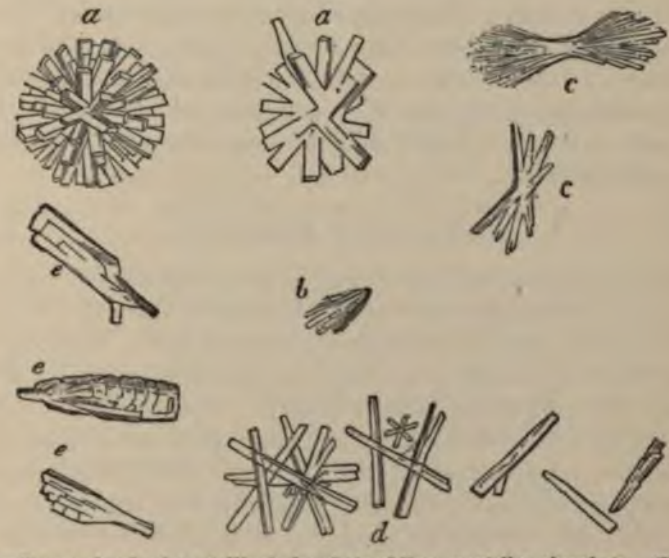

FIG. 68.—Stars and rods of crystallized phosphate of lime, or stellar phosphate. (Roberts.)

sential contingent to the formation of these crystals, and if the urine subsequently to their formation increase in acidity, they may spontaneously disappear.

3. *The Phosphate of Ammonia and Magnesia, or the Triple Phosphate.*—This insoluble crystalline compound is most usually encountered with the amorphous phosphate of lime. It is easily soluble in acids, and yet it may be found in urine which is feebly acid. If alone, the deposit has a fine crystalline, sugar-like appearance, and sparkling crystals may float in the urine and adhere to the sides of the vessel or form a glaze upon the surface. The usual form is the well-known coffin-lid-like crystal, a triangular prism with bevelled ends, but the edges and sides are often eroded by the action of an acid flow from the healthy kidneys, and the crystals assume a great variety of appearance in consequence. I have encountered this rare deposit alone and in fresh non-ammoniacal urine a few times only in

surgical practice. The most startling instance was in a boy aged eight who consulted me on account of hæmaturia of a painless and profuse character, which was proved to be due to fibro-sarcomatous polypi of the bladder. It is most often met with in urine which has become alkaline from volatile alkali.* This depends on the breaking up of the urea into carbonate of ammonia, by means of a ferment (micrococcus ureæ) generally introduced by the surgeon and increased by the alkaline conditions and the mucous discharge from the bladder which it excites. Carbonate of ammonia at once throws down the earthy salts, and the triple salt of ammonio-magnesium phosphate results. Sometimes when a large amount of pus is present it may be acted upon by the alkalies to produce thick ropy masses of muco-pus. It affords at one and the same time an evidence of fermentation, of ammoniacal urine, and of some severe catarrhal affection of the urinary tract.

Detection of Phosphates.

The urine is treated with caustic potash and heated. The phosphates are precipitated as earthy phosphates. By the addition of ammonia they may be precipitated without heat. The amount of deposit seen on cooling is a rough but practical bedside test of the quantity of earthy phosphates present in the urine.

To detect the presence of phosphoric acid in combination with alkalies, the urine is treated with ammonia and filtered, and to the filtrate an ammoniacal solution of magnesia and ammonia is added, whereby the phosphates are precipitated as triple phosphates.

Another method is to treat the filtrate with acetic acid, when the further addition of uranium solution yields a yellowish white precipitate.

The same filtrate with perchloride of iron solution gives a white precipitate, which becomes yellow on the addition of more perchloride.

Estimation of Phosphoric Acid.†

To urine which contains the phosphates as acid phosphates, a solution of uranium acetate or nitrate is added until an excess of the reagent first becomes appreciable. If the nitrate be used free nitric acid is formed, and causes a part of the precipitated uranium phos-

* Volatile alkaline urine is so called because the blue stain which it gives to red litmus disappears on drying. Fixed alkaline urine, on the other hand, imparts a permanent blue stain to red litmus.

† From von Jaksch.

phates to redissolve. To prevent this, in practice a little sodium acetate is added to the urine before titration with uranium nitrate. As an indicator a little tincture of cochineal is employed. This yields a green precipitate in presence of a uranium salt in excess. Instead of the cochineal fluid a solution of potassium ferrocyanide, 1 in 10, may be used. This reagent deposits a deep-brown precipitate with a mere trace of uranium salt. This test, however, is less sensitive in the presence of acetate of soda than in simple watery solutions. Hence it is necessary to use a definite quantity of the salt, and to take care that the proportion is maintained in preparing the titration fluid.

The solutions required for this process are:

1. *Solution of Acetate of Soda.*—One hundred grams of acetate of soda are dissolved in 800 c.c. of water, 100 c.c. of a 30-per-cent. solution of acetic acid are added, and the mixture is then made up to a litre. Five cubic centimetres are employed with 50 c.c. of urine.

2. *Cochineal Tincture.*—A cold infusion is made of a few grams of cochineal in a quarter of a litre of a fluid composed of three-fourths parts of water with one of alcohol, and the solution filtered for use.

3. *Solution of Uranium Oxide.*—About 20.3 gm. of commercial uranium oxide, purified and well dried, is dissolved in pure acetic acid, or in the smallest possible quantity of nitric acid, and the preparation is then made up to a litre. Of the mixture 1 c.c. indicates 5 mgm. of phosphoric acid.

4. *A Solution Containing a Definite Quantity of Phosphoric Acid.*—Fifty cubic centimetres should contain precisely 0.1 gm. P_2O_5. The preparation is made by dissolving 10.085 gm. of neutral phosphate of soda in a litre of water. The commercial salt should be crystallized from solution to obtain it free from chlorine, so that no precipitate forms with nitrate of silver and nitric acid. The crystals are then placed on paper in a funnel, the neck of which is stopped with glass wool, and allowed to dry there until the mother liquor is no longer found to adhere to them. A known weight is then taken and rubbed up in a mortar and a portion of the powder submitted to a gentle heat in a platinum crucible, and finally incinerated. Two hundred and sixty-six grams of sodium-pyrophosphate, $Na_4P_2O_7$, correspond to 716 gm. $Na_2HPO_4+12H_2O$. Consequently that quantity of the dried crystals which, when incinerated, yields 266 gm. corresponds to 716 gm. of pure phosphate of soda.

Titration Process.

Fifty cubic centimetres of the phosphatic solution (4) are measured in a flask, 5 c.c. of the solution of acetate of soda (1) and a few

drops of cochineal tincture (2) are added, the mixture is boiled, and the uranium solution (3) is gradually supplied until the mixture becomes slightly but permanently green on shaking. In the process a high temperature should be maintained, to promote the formation of uranium phosphates. When ferrocyanide of potassium is used as the indicator, the addition of the uranium solution is suspended when the precipitate ceases to form. The fluid is again heated and a drop is tested by adding to it a drop of ferrocyanide in a porcelain capsule. The further supply of uranium solution is regulated by the earliest appearance of a brown color in the specimens successively tested.

The uranium solution is now diluted according to the quantity found to be necessary, as above, in such proportion that 20 c.c. shall just suffice for the titration of 50 c.c. of the phosphoric acid solution.

Now, 50 c.c. of the phosphoric solution represents 0.1 gm. P_2O_5, and consequently 20 c.c. of the diluted uranium solution also corresponds to 0.1 gm. P_2O_5.

The titration process is repeated with the urine in precisely the same manner as before: 50 c.c. are taken, 5 c.c. acetate of soda and a little cochineal added, and the mixture heated and the terminal reaction sought.

Every cubic centimetre of the uranium oxide solution employed in titration represents 5 mgm. P_2O_5. Hence the phosphoric acid contained in 55 c.c. of urine may be calculated by multiplying the number of cubic centimetres of uranium oxide solution used by 0.005. The result is the quantity of phosphoric acid in grams contained in 50 c.c. of urine. It is advisable in each case to make two such investigations and to take the mean of their results.

Transient Phosphatic Urine.

In this class the urine does not contain phosphates in excess. Its normal quantum of amorphous phosphate of lime (bone earth) is merely thrown down by reason of an increased alkalinity of the urine.

It may appear in patients in complete health, who have indulged in sweet or sub-acid fruits, or in sparkling beverages, or it occurs in those who are suffering from the depressing effects of sexual indulgence or habitual masturbation. Those whose urine has been rendered alkaline by medicines, such as the carbonates, the acetates, and the citrates of the alkalies also pass heavy deposits of earthy phosphates. The urine may be turbid only once and during the rest of the day it may be quite clear. At other times the turbidity may last for several days, but it is not constant, nor does it produce any marked symptoms beyond a slight listlessness and loss of spirits.

Catarrhal conditions of the prostate and bladder, the result of gonorrhœa, may or may not cause the transient deposition of earthy phosphates.

It is certain that phosphatic urine is often met with in patients suffering from posterior urethritis, mild cystitis, or pyelitis, and that these two and independent troubles react upon and accentuate each other; thus the furred, spongy surface of the inflamed mucous membrane resents the alkalinity of the urine and favors the deposition of phosphates by further depressing the acidity of the secretion. This reaction is carried out without the formation of mucus or the intervention of the micrococcus ureæ, so that the triple phosphates are not discovered in the urine, but appear in a later stage or severer grade.

Secondary Phosphatic Deposits in Septic Urine.

The phosphatic deposit which is thrown down by the volatile ammonia of decomposition is a combination of triple phosphates and lime phosphates with an occasional small admixture of urate of ammonia and carbonate of lime. It is passed either in whitish clumps mixed with mucus, or it is deposited on abraded and swollen rugæ of the bladder, on the salient parts of a necrotic growth, or upon some nucleus, such as that afforded by a calculus or a foreign body. The time at which the secondary deposit commences is quite uncertain, depending as it does on the onset of cystitis.

True Phosphaturia.*

In true phosphaturia the elimination of alkaline and earthy salts is often greatly increased; instead of two or three grams of phosphoric acid being excreted in twenty-four hours, the amount may rise to seven or nine grams (Ralfe).

This increase is usually marked by the appearance of a heavy, soft, whitish deposit of phosphate of calcium, generally of the amorphous type, or the urine may in rarer cases be acid and without deposit, and the presence and amount of the phosphoric acid are discoverable only when a quantitative estimation of that substance is made.

Dr. Hassall attaches much importance to the forms in which the phosphate is deposited, and considered the crystallized phosphate of lime † as an indication of grave constitutional disturbance. Although

* The work done by Tessier and Ralfe in phosphatic diabetes has been freely drawn upon by the writer of this article.

† The formation of these crystals simply depends on the amount of lime present and the degree of acidity of the urine. They can generally be produced by the ad-

Bence Jones and Dickinson combat this view, they agree as to the correlation which Prout pointed out as existing between nervous irritation and exhaustion and the excessive output of phosphate of lime.

It is still uncertain as to whether the constitutional disturbance is not more connected with the lime constituent than with the phosphate.

Clinical Features and Symptoms of Phosphaturia.

These vary greatly, depending probably upon the grade of the loss and the length of time during which it has existed. Most writers have a sharply stamped clinical picture of the type of patient who is thus suffering. Thus Dickinson says: "I have learnt to recognize the manner of a man who is suffering from phosphaturia. He is nervous and mobile, of hypochondriacal temperament, having perhaps half latent gouty characteristics."

The symptoms include the phenomena of nervous irritability, of functional derangement of the digestive organs, and of widespread and obstinate neuralgias, especially those of the pelvic viscera. Thus patients may be emotional, excitable, extremely wakeful, they are tortured by presentiments and profoundly depressed and melancholic. Vertigo is sometimes complained of, the gait is unsteady, the hands tremulous. The tongue is pale and flabby, deeply indented by the teeth or coated with a white and moist fur. Anorexia and constipation are usually complained of. Abnormal sensations, such as numbness of the legs or vague backaches or limb weariness, are generally present. The urine is usually increased in amount, frequency of micturition being observed in consequence, and there is also the vesical irritability (urethral burning) which is the direct outcome of phosphatic irritation. The whole urinary tract sympathizes, but the chief section to bear the discomfort is the vesical neck. As the case progresses it is said to become similar in some respects to diabetes insipidus. In fact Tessier has proposed to give the name of phosphatic diabetes to this complaint.

Ralfe, to whom we owe a valuable addition to our knowledge of the subject, records a number of well-marked cases, from which the following two examples are taken:

Increased Elimination of Phosphoric Acid; Moderate Polyuria, Hypochondriasis, Rheumatic Pains in the Loins; Emaciation.—A small but well-built man, aged 25, attributes his illness to overwork. No history of syphilis. Temperate habits; has a pale, anxious, hag-

ministration of lime or its vegetable salts until the urine becomes charged with lime, while its acidity is lessened (Dickinson, "Renal Affections," vol. iii., p. 1,234).

gard expression. States that he has been ailing for some months, has lost flesh, and complains of a feeling of extreme nervousness and exhaustion, with frequent fits of trembling. Constant tearing pains in the loins, often shooting round the pelvic region with cramp-like spasms in the lower parts of the abdomen.

No lightning pains, patellar reflex unimpaired. Vision perfectly distinct. No apparent disease of the abdominal or thoracic viscera. Digestion fairly good, bowels constipated. Urine pale, whey-like, of medium specific quantity, alkaline reaction, no sugar, no albumin. Patient states that he passes more urine than he should and is frequently disturbed at night to void it. He was instructed how to collect and measure it, and was told to bring a sample of the mixed twenty-four hours' urine at the next visit. He did not comply with all the conditions necessary for accurate measurement, and it was not until October 21st that satisfactory evidence was given that the instructions had been carefully carried out. By that time he had been five weeks under treatment with mineral acids and nux vomica, and had improved to some extent.

Analysis of Urine Passed in Twenty-four Hours.—October 21st: Quantity 2,300 c.c., sp. gr. 1.015, reaction alkaline. Phosphoric acid 5.8 gm. or nearly treble what it should be for a man of his weight. Ordered codeine pill, one-third of a grain, and a mixture of bromide of potassium and nux vomica.

November 18th: Very much improved, is gaining weight, feels stronger, has nearly lost the pains; the discharge of urine is still more abundant than it should be. The patient is to collect and measure as before and to bring a sample at his next visit. To continue the mixtures but to leave off the codeine.

November 25th: Analysis of urine: Quantity 2,300 c.c., sp. gr. 1.015, reaction alkaline, phosphoric acid 5.8 gm.

Excessive Elimination of Phosphoric Acid, No Polyuria, Hypochondriasis, Enormous Quantities of Calcium Oxalate in the Urine.—A gentleman's servant, aged 27. First came under observation September 28th, 1880. He is a thin, spare man weighing about 120 pounds, of a sallow, haggard complexion. No history of syphilis; habits temperate. Complains of aching pains especially in the loins, shooting down the hips, and occasionally affecting the bladder and testicles. Alleged loss of virile power. Abdominal organs and thoracic organs apparently healthy. Digestion fair, bowels constipated. Feels very wretched and depressed. Urine passed at the time of visit (11 A.M.) acid, sp. gr. 1.028, containing 8 gm. of phosphoric acid in 1,000 c.c. The secretion of urine, he said, was not excessive; he was rarely troubled during the day but frequently at night with calls to micturate. He was requested to collect and measure the urine for a few days, and send a note with regard to the quantity passed in the twenty-four hours. This proved to be just under two pints, or about 1,100 c.c. The urine he passed at the time of his visit deposited in a few hours an enormous quantity of oxalate of lime, but contained no sugar, no albumin. Ordered codeine pill, a quarter of a grain, at night, and a mixture of hydrochloric acid in nux vomica and cod-liver oil.

November 18th: Is much better. Less pain in loins, is not so despondent, though he still fears he is impotent; confesses, however, to occasional manifestations of "his nature." To discontinue codeine and to take phosphorus pills, one-sixtieth of a grain instead. To collect urine for twenty-four hours, and to send it for examination.

December 1st: Quantity 1,520 c.c., sp. gr. 1.022. Urea 41.2 gm., phosphoric acid 5.2 gm. Still under observation.

Causation.

Our knowledge of the causes for the increased production of phosphate, or whether the train of symptoms ascribed to the loss is due to the lime or to the phosphatic constituents of the bone earth, is scanty and unreliable.

The following clinical clues are, however, established:

The Source of the Lime from Bone.—In osteomalacia, the urine contains from three to four times the amount of earthy phosphates that it normally eliminates. The phosphaturia is constant and not periodical. That the supply is derived from the bones is obvious, from the following estimate of lime salts in bone: In normal bone there is from 60.5 to 70.2 per cent. of lime salts. In osteomalacia 29.17 per cent. In the last stages of osteomalacia 1.83 per cent. So great is the deposit of phosphate of lime in the urine that stones form in the kidneys and even the bladder, except when disease of the kidneys checks the output, in which case the deposit of the lime salts is found in other organs.

In rickets the bones soften and bend, often to a remarkable extent, proving clinically, what has been established chemically, that the withdrawal of the lime salts is great. In these cases also phosphaturia is noticed at some time or other in the course of the disease, and the phosphates may rise to four or five times the normal amount. Although they are not always deposited as earthy phosphates, yet they are held in solution by the large amount of lactic acid which is present in the urine.

As a link in the chain of associated conditions the following statistics by Neumann may be mentioned: He collected 327 cases of fracture of the bones (fragilitas ossium), these fractures having for the most part taken place spontaneously and the brittleness being due to the removal of the lime salts. Paralytic dementia occurred in 39.1 per cent.; imbecility in 28.1 per cent.; mania in 17.2 per cent.; melancholia in 6.3 per cent.; psychic insanity in 3.1 per cent.; other forms of mental disease in 1.6 per cent.

Phosphaturia was noticed in acute meningitis by Bence Jones, and in acute paroxysms of certain forms of mania by Sutherland and Be

Other Sources.—It has also been observed as a symptom occurring in progressive pernicious anæmia and preceding or accompanying such debilitating diseases as phthisis, cancer, and diabetes mellitus.

These observations are yet too limited to draw general conclusions from. We are, however, in a position to connect the appearance of phosphaturia with the destruction and waste of some tissue of the body. But whether in these conditions "it is due to increased metamorphosis of nervous matter or to the irritation of a still hypothetical co-ordinating chemical centre," or to the influence of a disturbed condition of the nervous system upon nutrition generally, it is at present impossible to decide (Ralfe).

Treatment.

The treatment of phosphaturia must, of course, depend on an appreciation of the exact cause, if this can be ascertained.

If the patient has had syphilis, the iodides and mercury may be tried, but they rarely give satisfactory results, and more can be done by cod-liver oil and tonics. The excessive output of phosphates must be controlled if possible, and the general health improved. A change to a dry bracing climate, the use of warm clothing, and of light, nutritious food, especially milk, is often sufficient to produce a marked improvement.

Drugs.—Opium or codeine is useful in all stages of phosphaturia. At the onset it may be given with a free hand, but later on it must be sparingly administered, on account of the digestive troubles to which it gives rise. Codeine is perhaps more useful in treating the polyuria which often accompanies the later stages of phosphaturia. Tonics are especially valuable, chief among them being acids and nux vomica or its equivalent strychnine. Quinine and iron take a subsidiary place. Maltine and cod-liver oil are often of great value. Warm baths followed by tepid douches are said by Ralfe to give great relief to the neuralgic pain, as well as to be calmative to the nervous system.

OXALURIA.

Definition.—The persistent appearance of a decided amount of oxalate of lime crystals in the urine constitutes the symptom known as oxaluria. The question of an oxalic acid diathesis or the passage of oxalate of lime in a crystalline form, and associated with decided nervous and dyspeptic symptoms, was raised by Golding Bird in 1842.

Writing in 1853, this keen observer and able clinician still held to his original opinion in the face of much opposition, and declared, moreover, that deposits of oxalate of lime were of far more frequent occurrence in the urine than those of earthy phosphates. There is now no doubt that oxalate of lime exists in normal urine, also that persons in perfect health pass oxalate of lime crystals in small quantities. Moreover, when these crystals appear in larger quantities no associated symptoms may be present, this being well exemplified in children and adults with oxalate of lime calculi. It is also admitted, however, as equally certain, that there is a peculiar train of nervous and dyspeptic symptoms often associated with the passage of oxalate of lime, and that the term oxaluria nervosa or idiopathic oxaluria, used to express this condition, is valuable and distinctive as a clinical designation.

Micro-Chemical Tests.

Oxalic acid ($C_2H_2O_4$) is present in the urine in minute quantities in combination with potash, soda, and lime, two centigrams being passed in twenty-four hours (Fürbringer). When in excess a crystalline deposit of calcium oxalate (CaC_2O_4) is precipitated.

Microscopically the crystals are of two kinds, the more common being the distinctive and unmistakable, strongly refracting octahedral crystals (shaped like envelopes). Much less frequently the crystals assume a dumb-bell shape, which is merely an oval or circular disc with rounded margins, and a depression in the centre on either face. These are said by Ord to result from slow precipitation in the presence of colloid matter. The crystals are insoluble in vegetable acids, alcohol, ether, or water, but they dissolve readily in mineral acids. Oxalic acid is often associated with uric acid and urates (one-third of the cases—Bird); urea is also present in greater proportion than natural (30 per cent. of the cases—Bird).

More rarely an excess of phosphates is present. To estimate the amount of oxalic acid in the urine—for oxaluria as a morbid state cannot be measured by the microscope alone, since a large proportion of oxalic acid may be in solution—the following method is advised:

Quantitative Estimation of Oxalic Acid (Neubauer's Method).

The urine passed during twenty-four hours is accurately measured and treated first with calcium chloride and ammonia, then with acetic acid until it has a slightly acid reaction, and afterward a little alcoholic solution of thymol is added to restrain the development of microorganisms. The mixture is allowed to stand for some time, when

the white precipitate which forms is separated on a filter, and (together with the latter) is placed in hydrochloric acid, gently heated, the fluid filtered off, and the filter washed with water until it no longer has an acid reaction. The collected filtrate is evaporated to a small bulk in a capsule on the water-bath, then placed in a strong glass cylinder, and the capsule in which it was evaporated is washed with dilute hydrochloric acid and water, the washings being added to the fluid in the cylinder. Ammonia solution is then poured upon the surface of the latter, and the whole is tinted with a few drops of tincture of litmus. The mixture is allowed to stand for a considerable time. The precipitate which has formed is obtained on a so-called ash-free filter, the ash constituent of which has been accurately ascertained, and the oxalate of lime which adheres to the walls of the cylinder is removed on a glass rod guarded with an india-rubber ring, and is added to the precipitate on the filter. The latter is next freed from chlorine by washing with water and rinsing with acetic acid. The filter is then dried and ignited on a platinum crucible, which is heated to a constant degree in a blowpipe flame. By this means oxalate of lime is changed into lime. Now as 56 parts of lime correspond to 90 parts of oxalic acid, the quantity of the former obtained when multiplied by 1.6071 shows the quantity of oxalic acid in the urine taken. (Extracted from v. Jaksch, "Clinical Diagnosis," translated by James Cagney.)

Appearance of the Urine in Oxaluria.

A deposit of oxalate of lime is generally imperceptible to the naked eye; at most only a slight cloud of mucus is perceived. The crystals are said to be often deposited on the sides of conical urine glasses, in fine lines running transversely or obliquely, giving the appearance as if the glass were finely scratched, and it is stated that this is distinguished from a similar appearance which uric acid assumes when crystallizing on glass, by the greater coarseness of the line in the latter case and its more or less brown color (Roberts).

Circumstances under which Oxalate of Lime is Deposited.

The development of this salt appears to depend more upon the lime present in the urine than upon the oxalic acid.

"Given an excess of lime in the urine, oxalic acid, come it from whence it may, is seldom wanting. If the secretion be normally acid, much of the lime will appear as oxalates; if it be slightly acid or neutral, as acid or crystalline phosphate; if alkaline, as amorphous or basic phosphate. If, then, this deposit is formed persistently in

copious, clear, and pale urine, it may generally be regarded as the result of secretion, and as a sign of a constitutional state. When it is found in high-colored or uratic urine it may possibly have resulted from a decomposition of urates and be without clinical significance" (Dickinson).

The conditions under which oxalate of lime appears in the urine may be noticed under four headings (Jaksch):

1. Oxalates appearing as a physiological product;
2. Oxalates of accidental origin, or symptomatic;
3. Oxalates appearing vicariously;
4. True oxaluria, the so-called oxaluria nervosa.

A few remarks upon the first three headings will be sufficient.

1. *Oxalates Appearing as a Physiological Product.*—As has been stated, the normal urine contains oxalate of lime in minute quantities. Much greater, then, will be the product when oxalic acid is taken either with the food or with drugs.

Lime Water.—It is supposed that the frequency of lime oxalate calculi in districts supplied with lime-stone water is due to the presence of this mineral in the water.

Drugs and Diet.—Oxalic acid and its compounds, even the insoluble oxalate of lime, when introduced into the stomach pass into the urine. Thus Wohler (Roberts, "Urinary Diseases," 4th ed., p. 84) found that oxalic acid given to dogs caused oxalate of lime to appear in the urine.

Piotrowsky confirmed these results by experiments on himself. He took in divided doses from 80 to 100 grains of oxalic acid in the course of six hours and found that from 8 to 14 per cent. appeared in the urine as oxalate of lime mixed with a little alkaline oxalate.

In slight cases of poisoning by oxalic acid much oxalate of lime appears in the urine. Many fruits, vegetables, and other articles of diet contain this substance; such are turnips, onions, cauliflower, tomatoes, spinach, sorrel, endive, purslain, carrots, parsnips, parsley, celery, asparagus, apples, pears, pomegranates, grapes; also drinks that contain carbonic acid gas, as seltzer water and champagne. The excessive use of sweetmeats leads to an excretion of oxalic acid, also the exhibition of some drugs, such as rhubarb, squills, gentian, valerian, and cinnamon. The ingestion of any of these by persons predisposed to the formation of oxalates causes the appearance of oxalate of lime crystals in the urine.

2. *Oxalates Appearing Symptomatically or in the Course of Acute or Chronic Disease.*—The appearance of oxalates as the result of increased tissue metabolism in the course of acute or chronic disease is usually transitory and without special pathological significance, for any in-

terference with the digestive processes or with free respiration will cause a copious deposit of oxalates in the urine.

It has been noted in pulmonary and cardiac affections, in icterus (Schulzer and Fürbringer), and in the convalescence of acute rheumatism. In cases of intestinal and gastric catarrh it has been found to follow as a result of a superabundance of amylaceous or saccharine food. It has also been found in cases of cyclic albuminuria.

Oxalates Appearing Vicariously.—V. Jaksch states that oxaluria may appear vicariously in diabetes mellitus.

Idiopathic Oxaluria—Oxaluria Nervosa.

Putting aside what may be termed the physiological, accidental, and vicarious causes just mentioned for the production of oxalate of lime calculi in the urine, there remains a class of cases in which a constant of this salt appears in the urine, and it is to this class that the terms oxaluria, idiopathic oxaluria, oxalic diathesis, oxaluria nervosa have been applied. It must be acknowledged that we know very little concerning the causes of this condition, and though the literature is as abundant as it is theoretical, it is at the same time confusingly polemic.

Sir William Roberts is strongly convinced that oxaluria is only one of a long list of symptoms, and one having the least significance, and many well-known authorities support him in this view. On the other hand, the opinions expressed by Prout, Bird, and Begbie are indorsed by many, such as Cantani, v. Jaksch, Peyer, Ultzmann, and Oberländer. This view is, that there are certain complaints characterized by pains in the back and loins attended by rapid emaciation in which the only other subjective symptom is an excessive elimination of oxalic acid in the urine.

Dr. Bird ("Urinary Deposits," 5th ed., p. 251) gives the following account of the symptoms which accompany oxaluria: "They" (the patients) "are generally much emaciated excepting in slight cases, extremely nervous, painfully susceptible to external impressions, often hypochondriacal to an extreme degree, and in very many cases labor under the impression that they are about to fall victims to consumption. They complain bitterly of incapacity of exerting themselves, the slightest exertion bringing on fatigue. Some feverish excitement with parching of the palms of the hands and soles of the feet, especially in the evening, is often present in severe cases. In temper they are irritable and excitable, in men the sexual power is generally deficient and often absent. A severe and constant pain, or sense of weight across the loins, is generally a prominent symptom,

with often some amount of irritability of the bladder. The mental faculties are generally but slightly affected, loss of memory being sometimes more or less present."

Cantani distinguishes two forms of oxaluria nervosa, in both of which the presence of oxalate of lime in the urine is pronounced. In the first the patients are emaciated and complain of a feeling of general discomfort and of digestive disturbances—dyspepsia, flatulence, and constipation; of sleeplessness, hypochondriasis, melancholia, capriciousness, bodily weakness, loss of energy, diminution of mental power, rheumatic pains. Often there are progressive emaciation, pain in the kidney region, eczema, and psoriasis. The urine is very acid and concentrated and dark, similar to that passed in febrile diseases. It is of a high specific gravity, and it is often also heavily charged with solids, uric acid, and urates. The second class includes obese patients who are troubled with the usual loin pains, but also complain of characteristic neuralgic lancinating pain along the whole length of the backbone, and along the extremities. Gastralgia is also present. Small purulent collections, such as furunculosis, carbuncle, and abscess, which perhaps result from the blockage of the capillaries with oxalate of lime, are suffered from. Nervous symptoms and great weakness are marked, but the patient does not emaciate. After an absolute flesh diet for some days not only does the oxalate of lime disappear from the urine, according to Cantani, but also the nervous feelings gradually abate. If neglected or badly handled such patients invariably form calculi in the bladder or kidney.

Beneke,* who has subjected this question to an elaborate examination, in the way of both experiment and observation, has formulated the following propositions:

1. Oxaluria, a condition which accompanies the lighter or severer forms of illness, has its proximate cause in an impeded metamorphosis, that is, in an insufficient activity of that stage of oxidation which changes oxalic acid into carbonic acid.

2. Oxalic acid has, if not its sole, its chief source in the azotized constituents of the blood and food; everything, therefore, which retards the metamorphosis of these constituents occasions oxaluria.

3. Such a retardation of the metamorphosis of the azotized constituents of the blood and food may be determined by the following causes:

a. Abuse of azotized articles of food (direct retardation).

b. Abuse of saccharine and starchy articles of food (indirect retardation).

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* Quoted by Roberts.

c. Insufficiency of the red blood corpuscles and eventually diminished oxidation.

d. Insufficient enjoyment of pure, fresh air.

e. Organic lesions which in any way impede respiration and the circulation of the blood.

f. Conditions of the nervous system which bear a character of depression, whether these arise primarily from mental derangement or from pathological states of the blood.

4. Excess of alkaline bases in the blood, as numerous observations tend to show, plays an important part among the etiological conditions of oxaluria; and it is not improbable that an increased production of lactic and butyric acids in the digestive canal, consequent thereupon, impedes the development of the red blood corpuscles, and thereby generates that chlorotic state which so often occasions and accompanies oxaluria.

5. Catarrhal conditions of the intestinal mucous membrane, in case they are accompanied by oxaluria, have at most only an indirect causal relationship. They may determine oxaluria by causing deranged digestion but cannot be considered as the proximate cause.

It must be confessed that many of the patients who are supposed to be suffering from oxalic diathesis or oxaluria, have a well-marked history of sexual excess, that spermatozoa are not infrequently found in decided quantities in the urine accompanying the oxalate of lime, and that many of the symptoms which are supposed to be the direct result of the excess of oxalate of lime may be accounted for by the debilitating loss of seminal fluid. Moreover, many of the vague pains and depressed feelings can be accounted for by the renal resentment of fixed oxalate concretion or by the passage of the sharp irritating crystals along the sensitive urinary passages, arousing the reflex excitability of the prostatic urethra and its innumerable nervous connections.

Treatment.

The treatment of oxaluria should, if it is directed at all against the symptom, be essentially prophylactic; that is, our efforts should be directed to preventing the formation of that most distressing and painful of calculi, the oxalate of lime or mulberry calculus.

Clinicians may differ as to the concomitant nervous symptoms, but they cannot permit themselves to overlook the necessity of preventing as far as possible the formation of these crystals, which seem more ready than those of any other urinary deposit to cohere into concretions either in the renal tubes or pelvis, or in the bladder.

To prevent, therefore, the deposition of the oxalate of lime

crystals the diet should be carefully regulated although liberal. All vegetables and drugs containing oxalates must be avoided. All lime or hard water should be forbidden and replaced by boiled or rain or distilled water.

Sugar should be prohibited. Coffee and tea had better be replaced by milk. Alcohol need not be indulged in except by those who need the tonic or astringent of the red wines or bitter ale.

Fresh bracing air, such as that at the seashore, should be procured. As medicine, nitromuriatic acid has deservedly enjoyed a great repute. It should be combined with strychnine and the bitter infusions.

POLYURIA.

The secretion of an abnormal amount of urine, of low specific gravity, without sugar or albumin, and accompanied by extreme thirst, constitutes the essential element in the group of symptoms to which the name of polyuria, diabetes insipidus, polydipsia, or diuresis, has been given. Polyuria or diabetes insipidus has been classified since the days of Willis into groups, according to the character of the secretion; thus, hydruria included those cases in which the solid matters were deficient and the aqueous urine excessive; azoturia, in which there was an excess of urea, as well as an abnormal amount of urine. Many agree, however, with Sir W. Roberts that this classification is valueless in practice. Polyuria is a symptom of extra-renal disease, as well as of certain renal affections. The entire subject, however, needs careful reconstruction, based upon the records of cases in which chemical examination of the urine is exact. It is at present preferable, I submit, to classify polyuria clinically and without reference to the amount of urea present, and for this purpose a distinction must be drawn between a persistent excess of urine and a transient excess. The following table roughly separates the diseases into groups:

Persistent excess of urine.	Low s. g.	No sugar, but extreme thirst; urea increased.	Diabetes insipidus.
		Albumin with casts, but with pus or residual urine.	Chronic Bright's disease, such as granular kidney, amyloid kidney of advanced scrofulous or syphilitic affections.
		No albumin, but with residual urine.	Back renal pressure from ureteral twist and prostatic atony or direct renal irritation of prostatic origin.
Transient excess (usually diurnal).	Low s. g., clear.	(*a*) Sexual excess or debility (without inflammation). Dietetic idiosyncrasy—tea, beer, etc.	
		(*b*) Hypochondriasis, hysteria, nervousness.	

Persistent Excess (Diabetes Insipidus).*

Probably diabetes insipidus is purely an extra-renal disease, and due more to some train of nervous disturbances than to any direct renal irritation. Sir W. Roberts, who collected 120 examples, found that out of 42 cases, cerebral diseases or blows on the head were credited in 19 as being the cause of the polyuria. This is probably due to disturbance of the fourth ventricle. In three cases the affection was hereditary. In a large proportion of cases no cause could be assigned for the onset of the symptoms. In some of the traumatic cases the thirst and diuresis appeared with great severity on the day of the accident, in others they occurred later.

Dr. Matthews Duncan has related the case of a woman who had received a severe blow on the back of her head, and shortly after observed a great thirst and diuresis. These symptoms continued for fourteen years, at the end of which time she came under observation. The quantity of urine ranged from twenty to thirty pints daily. She enjoyed fair health and was the mother of four healthy children.

Symptoms.—The quantity of urine is usually greater than in saccharine diabetes. Fifteen, twenty, and even forty pints are frequently mentioned as being the daily amount excreted. One little girl under Sir W. Roberts' care passed rather more than one-third her own weight of urine daily for some weeks. The specific gravity is 1.003 to 1.007. The urine is limpid, colorless, and contains an excess of urea. The phosphates are sometimes increased (*vide* Phosphaturia).

The thirst is intense and insatiable; thus Dr. Willis' patient drank two bucketfuls daily. The urine, however, does not correspond to the amount imbibed, for when fluids are curtailed the diuresis continues and dehydration of the tissues results.

Fair health is recorded is many cases, but besides the tormenting thirst there are usually marked signs of constitutional disturbance. The temper is capricious, the patient sleepless, the bodily and mental strength is diminished, the sexual powers become weakened, the skin is hot and dry; there is emaciation, and lumbar pains are complained of. Frequency of micturition is, of course, increased. The

* "Diabetes insipidus is said to be distinguished from other low-specific-gravity polyurias by the large amount of urea which is excreted. The daily quantity of urea in diabetes insipidus is said to be three or four times the normal amount" (Dickinson, "On Diabetes," p. 206). In other forms of polyuria the amount of urea excreted is below the normal amount; the normal average is 500 grains daily in adult men between the ages of twenty and forty, or three and one-half grains per pound of the weight of the body.

patient usually succumbs to some intercurrent disease of the brain or to phthisis.

Prognosis.—Cases are recorded of persons who have been polyuric from twenty-four to fifty years. But these are usually congenital cases; the traumatic variety generally lasts only a few weeks or months.

Out of 77 cases of all kinds collected by Roberts, 16 were recorded as complete recoveries, 14 ended fatally, and the remaining 47 were still in progress when reported, though in some considerable amelioration had taken place. In the 16 recoveries the duration of the polyuria was comparatively short.*

Morbid Anatomy and Causation.—Our knowledge of the morbid changes noticeable in diabetes insipidus is slight. In some instances marked changes about the base of the brain, such as tuberculosis (Roberts, Dickinson), were discovered and in one there was a sarcomatous tumor in the region of the sella turcica (Fazio). In others, the neighborhood of the fourth ventricle was affected, by gumma in Ralfe's case, by gliosarcoma in a case recorded by Mosler. In one case the abdominal sympathetic was affected by malignant invasion. In most, visible changes had occurred in the urinary tract, but it is probable that these were secondary. Phthisical changes as a cause or consequence were found in several. The immediate anatomical cause for the polyuria is probably an impairment of the vasomotor nerves of the kidney permitting the rapid transudation of urine.

By what means the disturbance is excited, whether it be due to disease or traumatism of the base of the brain, especially of the fourth ventricle (Bernard), or of other parts of the nervous system, or to disease or injury of the solar plexus, is at present uncertain. It is undeniable that a large proportion of the cases followed injuries to the nervous centres, and in six cases (Roberts) palpable disease of the brain was found after death. Probably polyuria is merely a symptom of many nervous disorders.

Treatment.—Our therapeutic efforts, in the absence of specific knowledge of the cause or causes, are directed against the prominent symptoms—the thirst and diuresis. Enforced abstinence from fluids has nearly always proved unsuccessful, most distressing, and in one case at least positively harmful.† Among the remedies most strongly

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* "Of 47 cases still in progress when reported, the duration of the disease was mentioned in 35 [36?] instances. Five had continued for a year or under; 5 for between one and two years; 12 for between two and six years; 6 for between six and twelve years; 4 for between twelve and twenty-four years; and 4 for between twenty-four and fifty-nine years" (Sir W. Roberts, p. 238).

† Thus in Dr. Strange's case the amount of fluid ingested was cut down, and in

recommended is valerianate of zinc. It is administered in pills, in gradually increasing doses, until a daily dese of twenty grains is reached (Rayer). Good results from the exhibition of belladonna and ergot, or ergot alone, and of dilute nitromuriatic acid in drachm doses, have been obtained, also from the application of the constant galvanic current to the loins and hypochondria (Seidel, Külz, Althaus).

Chronic Bright's Disease.

Contracting granular kidney may exist for a considerable time and may even be "in a serious degree of development" before the patient is aware that there is anything amiss with him. For years the appetite and digestion may remain unimpaired, and health and strength may seem perfect. Suddenly the appetite fails, the patient becomes dyspeptic, he is tortured with thirst, and passes a great deal of urine, so that he fears that he is afflicted with diabetes. The urine is often secreted more abundantly at night. Thus, Professor Carl Bartels relates an extreme instance of nocturnal polyuria, in which 10½ pints (6,000 c.c.) were passed between 8 P.M. and 8 A.M. The urine had a specific gravity of 1.004, and contained albumin. Bartels says (Ziemssen's "Cyclopedia," Vol. XV., p. 431): "No other patient of mine ever passed so huge an amount. In only one private case could I feel sure I had really estimated the entire quantity of urine passed for a whole month. This patient excreted on an average 111 ounces (3,350 c.c.) daily. The fact is remarkable that the patients are invariably more tormented with the desire to pass water by night than by day. One of my private patients, for example, who throughout his day's work from 9 A.M. to 4 P.M. had no call to empty his bladder, was forced to get up three or four times every night to urinate. It appears that this greater frequency of the desire to micturate at night is founded upon the more abundant secretion which takes place at this time. The diurnal amount of urine passed by the above-mentioned patient was collected for a month, and upon twenty-six days out of this month the night urine was separated from that of the day. The day's urine, collected from 7 A.M. to 10 P.M., stood on an average at 1,370 c.c. (45 oz.), *i.e.*, 3 oz. per hour; while the night's urine, consisting of that passed during the nine night hours, presented an average of 2,190 c.c. (72 oz.), *i.e.*,

about a week's time headache and febrile disturbance ensued, weakness and anorexia being also noticed. Diarrhœa supervened, followed by vomiting, drowsiness, coma, and death. I cannot, however, accept this as a true case of diabetes insipidus because of the evidences of backward pressure on both ureters that were discovered post mortem (Beale's Archives, 1862, p. 276, quoted by Roberts).

8 oz. per hour. This patient was forced to get up at least four times each night to micturate. Another patient passed in ten successive nights upon an average 960 c.c., *i.e.*, 32 oz., each night, and upon the corresponding days only 65 c.c., *i.e.*, 21 oz."

The Polyuria of Direct Vesico-Prostatic Irritation.

Any congestion of the neck of the bladder, such as obtains in sexual excitement, is apt, in some people, to produce a temporarily increased flow of urine. When there is a permanent source of irritation which does not give rise to other symptoms, there is often a similar but persistent excess. Thus in the early stage of tuberculosis of the prostate, and in commencing senile enlargement of that organ, the kidney is often reflexly excited to increased activity, and a limpid polyuria results. It seems to me that when this is observed it forms a significant prodrome to disease of that body. Again, backward pressure from any partial urinary obstruction, as in hydronephrosis or advanced prostatic atony, produces the same phenomena, so that polyuria may be a symptom of surgical urinary disease. The transient form is sufficiently explained by the table and hardly needs further notice.

The treatment of this form of polyuria depends upon the cause; the reader is therefore referred to the various articles which specially deal with the diseases enumerated.

CHYLURIA.

Synonyms.—Galacturia, chylous urine.

Definition.

A milky appearance of urine, due to the admixture of chyle, constitutes the symptom known as chyluria. It is an evidence of an obstructive disease of the lymphatic trunks.

The change in the urine is perhaps the only constant characteristic of the disease, for the symptomatology is never exactly the same in any two patients. The former is, therefore, considered first.

Characters of the Urine in Chyluria.

Macroscopy.—The milky appearance of the urine is due to the escape into it of the contents of the lacteals and intestinal absorbents through some accidental communication. Unless some renal degeneration is also present, the urine is normal except that it contains a large amount of fat in a fine molecular condition, albumin, and fibrin.

In some cases the urine assumes a pinkish color from the presence of colored corpuscles like those of blood. This is so frequent and occasionally so abundant in certain cases as to justify the use of the term hæmato-chyluria (Osler).

Commonly—at least in India—says Lewis, the blood-like admixture, when present, is seen forming a shreddy, adherent coagulum at the bottom of the vessel after it has stood for some time. Fresh chyluric urine emits a strong milky or whey-like odor, which is increased by warming. If the urine be allowed to stand, it behaves in a similar fashion to blood; it coagulates into a semi-solid mass like blanc-mange, which then gradually contracts and separates into clot and a liquid. Should the clotting process take place in the kidney or—as it more often does—in the bladder, renal and vesical colic may ensue from mechanical obstruction.

The amount of urine is increased, being 80 to 100 oz. per diem, but this increase may be due in some measure to the addition of the chyle. The specific gravity varies between 1.007 and 1.020. If ether be added the fat is dissolved and the milky appearance is lost. If the urine be heated or nitric acid be added, albumin falls.

But the fatty matter is not constant in amount. It varies from 0.2 to 2 per cent. It is increased after meals. It also changes with the posture and the amount of exercise taken. Casein has not been discovered. The urea is not increased.

It must be recollected, however, that sometimes the urine is not chylous and milky, but lymphous and merely albuminous; it coagulates spontaneously into a substance which has been likened to "size," "calf's-foot jelly," or "currant jelly," a condition which much resembles the fibrinuria of Ultzmann (*cf.* Hæmaturia).

The chyluric and lymphuric urines are derived from chyle-bearing and lymph-bearing channels respectively, and it is the variable admixture of these two fluids which has probably caused so much deviation from the average which the published researches of the percentage constituents of chylous urine show. Thus Sir W. Roberts, whose careful work on the subject I have freely consulted, gives an abstract of nine analyses of chylous urine by different authors, no two being alike.

Microscopy.—The microscope reveals fat in a finely molecular condition, blood corpuscles, and often the nematoid entozoon the filaria sanguinis hominis. The filaria sanguinis hominis may generally be discovered in the urine at any time of the day, and in the blood of the patient *if drawn at night* (between 9 P.M. and 6 A.M.). In the urine the parasites are quickest found by taking up and teasing out gently one of the small clots. Patrick Manson says a better plan consists

in breaking up the coagulum in the urine with a glass rod as soon as it is formed, and then searching the sediment which, after an hour or two, collects at the bottom of the vessel, in the same way as is customary to examine for "casts." As large a slide as is practicable ought to be examined, and a low power employed in the first instance, as it often happens that the filariæ are present in very small numbers, and may readily be overlooked if a small quantity of the sediment only is examined or if a high power is employed.

Etiology and Pathology.

There is no doubt, I think, but that the evidence at our command allows of a division of chyluria into parasitic and non-parasitic varieties. The knowledge, however, that we now possess of the parasitic form enables us to surmise the causes for the non-parasitic group.

Parasitic Cases.—To make the etiology clear it is necessary to give a brief account of the hæmatozoon—the filaria sanguinis hominis, which has a definite causal relationship to chyluria. For a fuller review of this microscopic nematoid entozoon the reader is referred to the article on parasites.

The explanation now generally accepted for the appearance of chyle in the urine was first put forward by Dr. Vandyke Carter in 1861. Dr. Vandyke Carter advocated the view that a direct communication existed between the chyle-carrying vessels and the urinary tracts. This, which was in 1862 a theory, is now a certainty, for the parasite which induces such widespread changes in the lymphatic system has been discovered, and a multitude of observations have been made in recent years upon diseases allied to chyluria, such as lymph scrotum, lymph hydrocele, craw-craw, etc., which prove that the escape of chyle through abnormal channels is due to some direct communication between dilated lymphatics and the surface. My careful dissection of Dr. Mackenzie's patient (see below), and my discovery of the dilated lymphatics and blocked thoracic duct, moreover, leave no doubt but that the cause of the appearance of chyle in the urine is the accidental communication between the chyle-bearing vessels and some part of the urinary tract.

The part played by the parental worm (filaria sanguinis hominis) *and its embryo:*

In 1866 Wucherer, of Bahia, discovered the embryo filariæ in chylous urine, several of them being in active motion. In 1870 Dr. Lewis, of Calcutta, being ignorant of Wucherer's discovery, found in chyluric urine numerous living nematoid worms, and in 1872 this indefatigable worker discovered the same entozoon in the blood of a Hindoo and in the blood of a chyluric patient.

In 1875, O'Neill found the embryo nematodes in the exudate from the skin in a disease known to the negroes of the West Coast of Africa as "*craw-craw*." The next step was taken by Dr. Bancroft, of Brisbane, who in 1876 detected filariæ in the blood of a little girl, aged ten, who was suffering from chyluria. Dr. Roberts, of Manchester (now Sir William Roberts), and Dr. Cobbold discovered in a specimen of this blood, which Dr. Bancroft sent to him, a solitary and empty egg-shell—a direct proof of the belief already entertained that the filaria was the larval stage of some larger nematoid worm.

In 1876 Carter, of India, found the parent worm in a lymphatic abscess and hydrocele of the spermatic cord. Dr. Bancroft announced the discovery of the parent parasite in a letter to Dr. Cobbold, dated April 20th, 1877. It was a dead female obtained on December 31st, 1876, from a lymphatic abscess of the arm. Later on he obtained four living females from a chylous hydrocele. In 1877 Dr. Lewis discovered two living helminths, male and female, from a case of nævoid elephantiasis of the scrotum.

In 1880 Dr. Manson, of Amoy, discovered the parent worm, a mature female, in lymph scrotum. Dr. Manson now advanced the view that the lymphatics, more frequently the distal vessels, are the chosen and natural habitat of the adult nematode; that the female lying in a lymphatic duct emits her young, which are carried into the lymph current to the lymphatic glands, and having a diameter about equal to the lymph corpuscles, aided by the power afforded by their own vigorous movements, they readily enter and traverse the gland tissue. Thus they pass gland after gland, and emerging into the efferent vessels are borne along the stream until the thoracic duct is reached, when they finally enter the blood itself (Mastin, "Annals of Surgery," Vol. III., p. 31, 1888).

Both Bancroft and Manson suspected there was some intermediate host, and Manson in 1878 discovered the embryo in the stomach of the culex mosquito. Subsequently he found that it was the female of a particular species of mosquito which performed the office of intermediary host. Dr. Manson demonstrated that the female of this special variety, penetrating the skin of a filarial subject, gorges herself with the blood of the victim of her attention, and, as it is usually at night when she makes the attack, with the filariæ which are then circulating in the blood current of this individual.

The mosquito then repairs to water to deposit her ova. Many of the embryo nematodes are digested, but some are expelled with the excreta, or having penetrated into and completed their development in the thoracic and abdominal tissues of the mosquito, bore through its body wall and escape as free nematodes. Probably they are swal-

lowed by the human subject with the water, but of this step we have no accurate knowledge as yet. On re-entering the human body the parasite reaches sexual maturity and locates in the lymphatic system. Here probably conjunction of the sexes takes place and filarial embryos are produced in vast numbers.

Dr. Manson's researches were confirmed by Dr. Lewis, of Calcutta, who found four out of eight mosquitoes captured at random in one of the servant's houses contained specimens of embryos. Dr. Araugo, of Bahia, verified the presence of the embryos in mosquitoes who had fed upon the blood of a French priest afflicted with filaria. Drs. Bancroft, of Brisbane, and Sonsino, of Cairo, corroborate these facts.

The parent worm produces either living embryos or aborts and emits these in an immature stage in the shape of semi-spherical ova.

The former are one seventy-fifth of an inch long and their breadth is about the diameter of a red blood corpuscle. Their size enables the free embryos to penetrate the walls of the capillaries, but the unhatched ova in which the embryos lie coiled up are of larger diameter, and their size renders their escape from the finer capillaries impossible. They are, therefore, arrested in the first lymphatic gland which may be reached. Blockage of the gland ensues, more filariæ accumulate behind the obstruction, and a localized lymphatic congestion results; the process spreads, with consequent dilatation and varicosity of the lymph vessels which drain into that gland.

The greater the number of glands thus affected the wider will be the area of dilated lymph channels, the highest expression of damage due to obstruction being found when the thoracic duct is impeded, as in Mackenzie's case. Thus, it is only needed for a prolific female, aborting or miscarrying from some as yet inexplicable cause, to expel her ova in numbers into the lymphatic circulation, to produce plugging more or less complete of the lymphatic glands through a limited or an extended area according to the location of the worm (Mastin).

The blockage of the lymphatic trunks may take place in any part of the body, hence many lymphatic diseases, which were formerly considered separate and distinct, are now established as being due to filarial obstruction.

Dr. Bancroft enumerates the following conditions among others as being probably associated with filariæ:

Chylocele, varicocele, elastic tumors in the axilla and groin (helminthiasis elastica), lymph vesicles bursting on the scrotum and abdomen, skin diseases (craw-craw), elephantiasis of the scrotum, abscess of the scrotum.

In a remarkable case published by Sir William Roberts in 1868 a

coagulable chylo-lymphous discharge escaped from open vesicles which had formed over the surface of the abdomen. After death it was found that the cutis vera and the subcutaneous tissue were traversed by short lymphatic channels or lacunæ, from the width of a crow-quill to that of a hair—apparently a vast intercommunicating lymphatic mesh.

The immediate cause for the appearance of chyle in the urine is the direct communication between the varicosed and dilated lacteal channels and some part of the urinary tract, combined with intermittent or chronic obstruction to the thoracic duct or a large branch of the same.

This communication may take place through the lymphatics of the bladder with the interior of that viscus, as was proved by Havelburg in the case a woman who had lived in Brazil for fourteen years. It is reported that the urethra of this patient was so dilated by the passage of chylous clots that a catheter was easily inserted into the ureter, and, being retained there for two hours, clear urine flowed through it. This showed that the entrance of chyle was due to the direct lesion in the bladder. She had also a small patch of elephantiasis in the integument of the epigastric region. At the post-mortem a large lymphatic sac was found on the left side extending from the true pelvis to the kidney. This was full of white blood-streaked fluid. The left side of the upper part of the bladder was quite imbedded in the recesses of the sac referred to, and when opened the bladder was found to be perforated in this situation.

But in two cases which I had the opportunity of examining, the orifice of communication was situated in the *upper* part of the urinary tract. The first, which is known as Dr. Mackenzie's case, I dissected in a somewhat novel manner, after a plan I had followed in working with Professor Braune, of Leipzig, upon the valves of minute venous channels of the abdominal walls.* I mention this here as it is, in my opinion, the only sure method of dissecting such flimsy structures as dilated lymphatic sacs, and believe with Sir W. Roberts that the failure to discover communications is due to the want of deliberate care and of some method of counteracting the collapse of the thin-walled sacs after death.

By means of light clips with broad points and a constant stream of oil and water faintly colored with blue, each section of the varicosed lymphatics can be rendered tense and cleaned, and their intercommunicating channels dissected out without rupture of their walls.

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* *Cf.* Braune and Fenwick: "Die Venen der vorderen Rumpfwand des Menschen." Leipzig, 1884.

In Dr. Mackenzie's case the dissection took, I believe, two or three months, and it was carried out piece by piece, starting from the orifice of communication of the thoracic duct with the left internal jugular and subclavian veins. Unfortunately circumstances prevented me from describing the dissection, but my late colleague, Dr. Anderson, undertook to do so, partly from the specimen and partly from the drawing which had been carefully done under my direction by Mr. Burgess. Dr. Anderson describes the dissection as follows:

"The thoracic duct commences in a dense mass of lymphatic tissue and glands which extends from the bifurcation of the aorta below to the level of the aortic opening of the diaphragm above. Looked at from behind, this mass occupies the whole of the space between the kidneys, and is continuous below with the chains of lymphatic tissue on the iliac arteries. The mass consists very largely of enormous dilated lymph sinuses, which can here and there be inflated. The receptaculum chyli commences by two large lymph sinuses about the size of a pencil, one from each side of the aorta, and is joined opposite the aortic opening of the diaphragm by a third large sinus about the same size. The duct now ascends, sinuous and much pouched, for three to four inches, varying in diameter from three-eighths to half an inch, pervious for the first inch and a half above the aortic opening of the diaphragm, then filled with a loose clot for an inch and a half, after which it is lost in a tough, thick mass (query, inflammatory?). (The occluded point in the thoracic duct when opened was found to contain a very long, twisted clot, tapering at the end.) About four inches above this point, when it can again be traced, although still involved in dense tissue, it is now the size of a small crow-quill, impervious, and tending to the left side behind the aorta. At its termination in the angle between the left subclavian and internal jugular veins it passes through a mass of lymphatic tissue, is pervious, and about the size of a goose-quill. As stated, the iliac, the lumbar, and the renal lymphatics are very much enlarged, and the enlargement is specially marked in the left iliac and left renal lymphatics. Scattered throughout the left renal lymphatics are numerous hard, round masses, some the size of a pea, but mostly smaller. These masses manifestly occupy the lymph sinuses."

To this I may add, the calculi found in the lymphatics of the left renal pelvis were the size of small shot. They were composed apparently of layers of fatty material and were all adherent to the walls of the dilated lymphatics and usually behind the atrophic remains of valves. They were, in my opinion, the evidence of a slackening stream of chyle and were analogous to the small phleboliths which

are found in the prostatic plexuses of veins, each phlebolith being situated in this portion behind a diseased valve, and marking usually the partial or complete obliteration of the trunklet in which the phlebolith is found ("Venous System of the Bladder and Prostate," *Journal of Anatomy and Physiology*, 1892).

The actual site of communication between the lymphatics of the left renal pelvis and these extraordinarily dilated intercommunicating lymphatic chambers was not discovered, probably because the work was suddenly interrupted, but as there had been a history of left renal colic, and as the channels were not enlarged much beyond the edge of the pelvic brim, and as the bladder surroundings were not matted or thickened, the orifice of communication was probably in the left renal pelvis.

In a post-mortem examination of a case of chyluria, Dr. Lewis found vast numbers of filariæ in the kidneys. There were also "numerous translucent oil-like tubules of a somewhat varicose appearance running alongside the uriniferous tubes, as if the lymphatics or minute blood-vessels of the part had been plugged." (Roberts, *op. cit.*)

Lastly, I was able to demonstrate by means of the cystoscope a renal source in one chyluric patient under Mr. Clement Lucas, who kindly permitted me to examine the patient and relate the facts of the case. It was apparently of non-parasitic origin and occurred in a woman aged twenty-four.* A small swelling had been noticed at birth in the lumbar region, but this had since increased in size to that of a child's head. When she was seven years old the urine became thick and milky. Associated with the tumor was an extensive nævus invading the posterior aspect of the thigh. The swelling had a distinct limit, and appeared to be also nævoid in character. There was probably some communication between the swelling and the lymphatics around the kidney. Seen through the cystoscope the bladder was healthy, but the surface was blurred with milky deposit. Jets of milky fluid were distinctly seen to issue from the right ureter, and to mix rapidly with the surrounding medium.

Non-Parasitic Cases.—In almost all cases of chyluria, Manson says, when the parasite is properly looked for the filaria will be found in the urine and usually in the blood also. He thinks that the absence of filariæ does not always indicate that the case is not of parasitic origin, as there may be only one parent worm present, or all present may be of the same sex, and thus there are only sufficient for obstruction and not for the propagation of embryos.

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* The case was shown at the Clinical Society, April 26th. Lancet, p. 886, May 4th, 1889.

This view, though taken by one who has been foremost in elucidating this interesting and obscure disease, is not yet assented to. It is thought by many that the chyluria is in rare instances caused by some pressure such as that produced by a tumor, or constriction formed of inflammatory thickening, in or about the walls of the thoracic duct, but this condition has apparently not been proved to exist. Osler records a case of chyluria, which lasted thirteen years, in which filariæ were never found. Post-mortem examination showed that the abdominal lymph vessels were perfectly normal, that no parasites were present in any part of the lymphatic system, and that the urinary system was quite normal. He accordingly believes that there is a non-parasitic chyluria, but can offer no explanation of it.

Distribution.

This disease occurs endemically in Mauritius, East and West Indies, China, Brazil, Cuba, Bermuda, and Australia, and in most tropical or sub-tropical climates to some extent, but there are districts in these same countries which enjoy an immunity, similar to that of temperate climates, which depends entirely upon the distribution of the filaria. Where Europeans have been affected they have almost invariably travelled in those countries, but a few cases have been seen in patients who have never been abroad. Some of these have been explained by the fact that the mosquitoes may have been brought to our shores by trading-vessels, or that the varicosity and rupture of the lymphatic meshes were due to pressure by some inflammatory exudation or tumor upon one of the main chyle channels.

Symptomatology.

"The course of the disorder," says Roberts, "is marked by an irregularity and capriciousness which baffle explanation." The onset may be sudden, following a nervous shock or a fall, or after parturition; but usually it appears spontaneously.

Once the effection is established, the chylous urine may appear intermittently or be continuous. The interruptions are, I suspect, due to temporary blockages of the minute openings into the urinary channel, and the grounds for this belief are the following:

1. The appearance of chylous calculi in Mackenzie's case showed that the stream through the terminal intercommunicating channels had slackened and stagnated, and that inflammation had occurred to block one or more at least of the channels altogether. By this means the flow would cease until the back-pressure had opened up a fresh channel or set of channels, which would finally become thinned and

would burst. In those cases in which the intermission extends over years, it is probable that other channels are opened up which allow of the chyle finding its way into the thoracic duct by a circuitous route of absorbents.

2. It will be noticed that in two of the post-mortems recorded, Mackenzie's and Havelard's, the lymphatic varicosities extended along the ureter from the kidney to the bladder, as if the pressure which first found an outlet at the pelvis of the kidney was forced subsequently along the lymphatics which accompany the ureter and its surroundings. An analogue to this is the ordinary varicocele. Pressure abruptly checked in one vein by a valve passes off into an adjoining vessel.*

The intermissions in the appearance of chylous urine are very irregular. The chylous flow may cease for ten or more years and be again renewed. During the remissions the urine regains its normal character. Sometimes the attacks assume a certain periodicity. Thus in one case the urine was always chylous for eight days previous to menstruation; in another chylaria preceded or accompanied attacks of epilepsy or erysipelas. In Mr. Pearse's case it occurred when the patient was suckling her children and ceased on her weaning them.

There are also diurnal variations having a relation to meals, exercise, rest, and posture. Dr. Mackenzie observed in his case that alterations in the meal-times produced changes in the character of the urine. Thus the day urine almost completely coagulated and contained a considerable amount of blood, while the night urine did not form so large a coagulum and contained less blood, and was much more milky. An alteration of a few hours in the meal-times caused the characters of the day and night urine to approximate, and when the habits of day and night were completely reversed the conditions of the urine were similarly reversed.

Posture.—In Ackerman's case † normal urine was passed if the patient lay on his right side. Was the opening in this case into the left renal pelvis draining into the prevertebral lymphatics? This would explain the fact noticed that when the patient stood up the urine at once became chylous.‡

Intercurrent disease, such as an attack of gout, carbuncle or pneumonia, temporarily suspends the chylous discharge. Should the chylous urine clot, renal or vesical colic is noticed, and if renal colic is present it is absolute evidence of a renal source.

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* This is well shown by colored water injections.

† These and previous cases are quoted from Roberts, *op. cit.*

‡ This sounds somewhat similar to those cases in which pus from the antrum escapes only when the patient is in certain positions.

The course of the disorder is very irregular, and it may be of indefinite duration. The general health nearly always suffers more or less, there being marked general debility, lassitude, and depression, and often gradual emaciation. Beyond the chylous character of the urine there are generally no distinguishing symptoms, and the constitutional results are probably entirely due to the waste of nutritive material.

Filaria in the Blood.—Manson, in a systematic research at Amoy, found that one in every ten Chinamen had filaria in his blood, but most of these were in perfect health. He thinks that probably so long as the parent parasite is healthy it is innocuous; should it, however, die, it acts as a foreign body and sets up irritation around it; this causes great obstruction of the duct in which it is lying, and an abscess may result.

Dr. Manson discovered the most remarkable feature of the entire subject in noting that the parasite is found only *at night.* "Unless," he says, "there is some disturbance such as fever, interfering with the regular physiological rhythm of the body, filaria embryos invariably begin to appear in the circulation at sunset; their numbers gradually increase till midnight; during the early morning their numbers become fewer by degrees, and by nine or ten o'clock in the forenoon it is a very rare thing to find one in the blood." Dr. Cobbold not inaptly designated the phenomenon *filarial periodicity.* Dr. Myers of Formosa, Dr. Rennie, Dr. Adams, and Dr. Mackenzie not only confirmed this, but the latter also acutely showed that by making the patient change his hours of sleeping and waking, thus turning night into day, the filaria followed suit. The important fact of inversion of filarial periodicity was thus established.

Prognosis.

Death generally ensues from intercurrent disorders. Phthisis has occurred in a good many of the cases reported. One case lived fifty years with chyluria, another twenty-eight years, thus showing the slight constitutional effects which may be caused. On the other hand, it is stated that some patients in fair health, except for the chyluria, have been known to die unexpectedly, from no recognized acute disease.

Treatment.

Now that the true pathology of the disease is understood, the reason of the hopelessness, in most cases, of treatment is fully appreciated.

Manson insists that the main point is to endeavor to get the ruptured varix, by which the chyle is leaking into the urine, to heal; the patient therefore ought to be kept as much at rest as possible, by which means the ruptured lymphatic is afforded the best chance of healing.

Simpson, of Assam, reported four cases, in two of which the urine became natural in ten days after 5 gr. of gallic acid and from 4 to 15 minims of tincture of perchloride of iron, thrice daily, and two cases which cleared up in fourteen days under perchloride of iron and large doses of quinine. In one case, gallic acid and thymol were used with success. Waters and Bence Jones gave one or two drachms of gallic acid a day. Roberts speaks well of large and sustained doses of iodide of potassium.

In Guiana, it is stated (Roberts) that a decoction of mangrove bark, *Rhizophora racemosa*, has effected cures, and the seed of the *Nigella sativa* has also been lauded in India. Thymol is also advised by Laurie.

Pressure has been tried by Dickinson, an abdominal tourniquet being applied, and a partially successful endeavor to stop the regurgitation of chyle toward the lymphatics has been thus carried on, but this can be followed only by temporary relief.

Dickinson records a case in which chyluria disappeared after an injection of a solution of perchloride of iron into the bladder. On the whole, treatment is practically *nil*, as the parent worms cannot be dislodged from their habitat in the large lymphatic trunks of the abdomen, where for some reason they have become located.

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DISEASES

OF THE

FEMALE BLADDER AND URETHRA.

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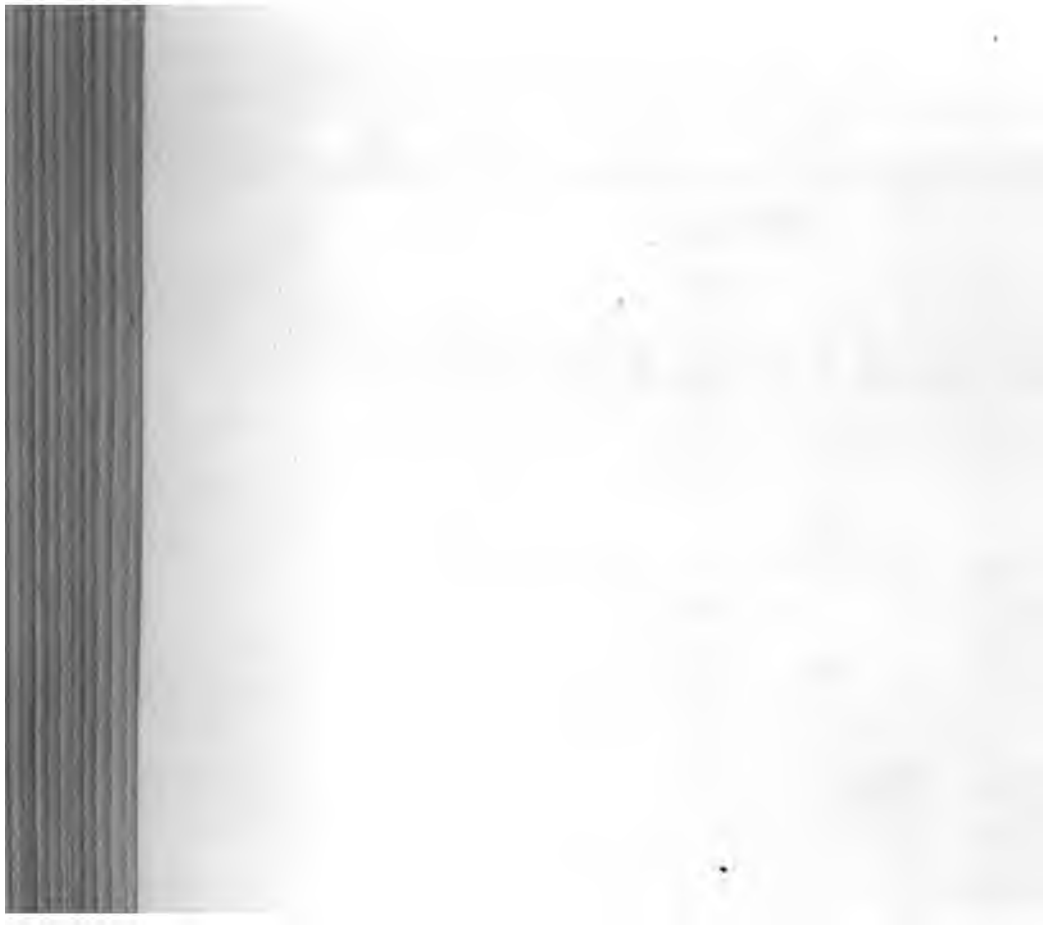

DISEASES OF THE FEMALE BLADDER AND URETHRA.

INTRODUCTORY.

Up to the present time diseases of the urethra, bladder, and ureters in women have been the most neglected field in the whole range of scientific medicine.

From the earliest times urinary affections in the male, although the organs are more inaccessible and the diseases consequently more difficult to treat, have commanded the painstaking attention of physicians and surgeons. These affections in the female on the other hand were either passed over on account of their similarity to those in the male, or the most obvious facts only, such as the comparative shortness of the female urethra, and the accessible position of the bladder and urethra in their relations to the vagina, were pointed out. There is a groundwork of reason in this neglect, for the commoner urinary diseases of men are far more apt to prove dangerous to life.

A further reason for the present ignorance regarding diseases of the lower urinary tract in women is the fact that they have not been made the subject of exclusive study by specialists. Gynecologists, to whom these diseases have been relegated by common consent, have with but few exceptions, counted on one hand, slighted these cases as being difficult or impossible to diagnose and intractable to treatment.

It is, however, a satisfaction to be able to say that this neglected branch of our art has finally been rescued from its obscurity by the methods which I shall describe in this article. Diseases of the bladder, ureters, and kidneys have now been brought within the easy range of intelligent diagnosis, so that without pain or injury to the patient, and without the intervention of any lens or mirror or fluid medium, the whole urinary tract in women may be examined and its diseases correctly diagnosed and successfully treated. Gynecology may now justly claim that at a single step this branch of the specialty has advanced beyond the kindred branch in male diseases.

Anatomy.

Some brief anatomical and physiological remarks concerning the urethra and bladder are a necessary preliminary to a consideration of the methods of examination and their pathological affections and treatment, but it is not my purpose to enter into the minute anatomical descriptions, which will be found upon consulting such works as Sappey and Henle.

Urethra.

The female urethra is from 3 to 4 cm. (1¼ to 1½ in.) long and 7 mm. (¼ in.) wide. It is almost straight, with a slightly sigmoid curve. Its external orifice normally appears as a vertical slit, the section of its canal proper stellate, while its internal orifice is transverse.

The urethra is lined by mucous membrane which in the contracted state is thrown into numerous folds. Many blood-vessels penetrate the mucosa and the connective tissue immediately beneath it, forming a cavernous network. Immediately outside the mucosa is a layer of circular muscular fibres, and outside of these again a layer of longitudinal fibres. At the neck of the bladder the circular fibres are so thickened as to form a distinct sphincter which controls the retention of the urine. No such sphincter has been satisfactorily demonstrated at the external orifice, although Luschka contended that one existed. Analogous to, and connected with, the *sphincter vaginæ*, the mucous folds of the urethra form three principal folds, one median on the wall toward the vagina, and one on each side. In the depressions to the right and left of the median fold lie pits and glands arranged longitudinally in groups. A dozen or more of these are found in a group. Near the lower end of the urethra these depressions are never more than little sacs in the mucosa lined with the same epithelium as the mucosa itself. Similarly placed near the upper part of the urethra are the acinous glands.

Just within the cutaneous margin of the urethra, one can discover on either side, posteriorly, a little orifice not quite a millimetre in diameter. Upon pressing the posterior surface of the urethra up against the pubis sometimes a small drop of fluid may be made to exude from these orifices. If a sound 1 mm. in diameter be introduced, it will be found to enter from 1½ to 2 or even 3 cm. (½ to 1¼ in.), never, however, passing beyond the internal orifice of the urethra. The tract thus sounded runs parallel to the urethra on either side and is sometimes considerably dilated. These openings are the orifices of the "glands," discovered by Prof. A. J. C. Skene and described

in the *American Journal of Obstetrics*, April, 1880. They are entirely different from the other small glands and pits found in groups throughout the urethra. The orifices of the urethral pits are for the most part wider than the portion of the pits immediately below, while on the contrary the orifices of these urethral tubules are regularly narrower than the succeeding portion of the canal. Care must be taken in sounding them not to push the sound through the gland wall, establishing a false passage. A further difference between these tubules and the urethral pits lies in the fact that the former are regularly confined to the most superficial layers of the mucosa, while the tubules enter the deeper layers. They are lined with a well-vascularized mucosa, upon which numerous fine openings are seen. These tubules attain their greatest development in the years of greatest sexual activity. Not infrequently their orifices lie exposed to view in multiparæ.

Schueller found occasionally a third tubule in the middle line, half-way between the normal orifices. Cross sections of these tubules show the lumen to be usually stellate, or linear, and the farther the section is made from the orifice, the more irregular is the form, the lumen dividing itself into numerous depressions and folds. Some of the higher sections show several canals lying close together, demonstrating the fact that the tubules have ended in a number of blind sacs. The course of the tubules is not straight. They are lined with mucosa like that of the urethra with loose connective tissue below it, and are abundantly supplied with the cavernous vessels. It is not probable, as has been asserted, that they represent or have anything to do with the terminal ends of Gärtner's ducts, which in fœtal life are lined with cuboidal ciliated epithelium.

One important anatomical peculiarity of the urethra has, strange to say, entirely escaped the notice of anatomists and clinicians. If a virginal vaginal orifice be examined, taking care merely to expose the parts without separating them, the urethral orifice will be found completely hidden, being covered by two lips, one on either side, in close connection with the anterior part of the hymen. By the approximation of these lips the cutaneous orifice forms a simple vertical line, from 2 or 3 to 10 mm. beyond the level of the vestibule. These folds are connected with the posterior part of the urethral orifice, and project up over the anterior portion of the orifice with the patient lying in the dorsal position. They are sometimes short and inconspicuous, at others long—longer relatively to the urethral orifice than are the labia minora relatively to the vaginal orifice. They are most marked at the period of greatest sexual activity, disappearing with age. They are also wont to disappear after numerous child-

births, being replaced by a patulous urethral orifice, without distinct labia. In cases where they have been partially destroyed their previous position is often indicated by a line crossing the urethral orifice, giving it a characteristic cruciform shape. These folds have a mechanical function, and are clearly intended to protect the mucous membrane of the urethra from mechanical injury and invasion by the micro-organisms so abundant in the vaginal secretions.

Bladder.

The female bladder occupies the cavity of the pelvis anterior to the uterus and broad ligaments, and above the vagina. It differs decidedly from the male bladder in its topographical relations and the form it assumes upon expansion.

Writers differ in their statements as to the form of the empty bladder. Berry Hart, for example, states that the normal empty

Fig. 69.—Showing the Normal Position of the Bladder when Empty.

female bladder presents an oval form in sagittal section and forms more or less of a continuous canal with the urethra. Schultze states, on the other hand, that in its contracted condition the upper wall comes to rest upon the lower in such a manner that the angle of flexion lies at the utero-vaginal junction. Anteriorly the angle of flexion lies below the top of the symphysis pubis. This gives the bladder the characteristic Y-shape (the stem of the Y being represented by the urethra) which has become so familiar through frozen sections. I am able to verify both of these observations. The bladder in a quiescent state assumes the Y-form, the upper hemisphere

resting in the lower like one saucer within another. When actively contracting, however, it assumes the ovoid form.

As the bladder fills with urine, the expansion is greatest at the sides, filling out the pockets in front of the broad ligaments, but the body of the uterus which normally lies in contact with it is not elevated in proportion to the degree of lateral expansion. The form of the distended bladder is an ovoid with its long axis transverse, and a deep depression in the middle, like a pair of saddle-bags.

It is only in cases of extreme distention that the long axis becomes vertical, in which case the uterus is thrown into retroposition and the bladder is brought in contact with the rectum as in the male pelvis. A close approximation to the conditions present in the male is also brought about by the operation for the extirpation of uterus, tubes, and ovaries now so frequently performed.

In considering the origin and course of the various affections of the female bladder it is important to bear in mind its intimate connection with the vagina, with the anterior part of the cervix uteri, and its relations, through the broad ligaments on either side, to the tubes and ovaries, which become especially intimate when the latter are enlarged and fixed by inflammatory disease and tend to push forward the broad ligaments so as to encroach upon the anterior part of the pelvis. From the connection thus established pelvic abscesses may be discharged through the bladder; dermoid cysts have been also known to empty their contents in this way, and I have seen a tubercular tubo-ovarian abscess break through and infect the bladder mucosa.

The importance of being familiar with the peculiar manner in which the bladder distends becomes evident, when we recall the frequency with which a few years ago the stump of a fibroid uterus was fastened in the lower angle of an abdominal wound, just above the symphysis pubis. In these cases it is at once evident that all possibility of distention in the median line in an antero-posterior or vertical direction is taken away. There is also a limitation of the distention in the same direction after suspension of the uterus to the anterior abdominal wall for the correction of retroflexion. In a case which appeared to be entirely normal, I have seen the bladder distended by about eight ounces of urine almost wholly in front of the left broad ligament. The thickness of the walls of the contracted bladder is ten or more millimetres; they become thinner upon distention, being 3 to 4 mm. thick when moderately distended. The mucous membrane in the contracted state is thrown into innumerable folds and convolutions, similar to those of the brain. The epithelium is two layers deep and extremely elastic.

The bladder also contains crypts and numerous branched acinous glands lined with cylindrical epithelium. The inner muscular layer of the bladder is connected with the mucosa by an extremely loose connective-tissue layer, excepting in the neighborhood of the trigonum. This muscular covering consists for the most part of two layers of smooth fibres of equal volume, the outer layer having a more or less vertical direction, while the inner is principally horizontal or ring-shaped (Henle). Among the most important anatomical features of the bladder are the ureteral orifices shortly to be spoken of.

In investigating and attempting to record the results of the examination of numerous cases of diseases of the bladder coming to my clinic, I have found a fresh study of the topographical relations from a practical standpoint to be absolutely necessary.

Topography.

The female bladder distended with air and inspected per urethram, by the speculum, as I shall describe farther on, has more or less the form of a hollow ovoid, into which the observer is peeping through a hole in its wall; by turning the speculum, it is possible to gain a view of every portion of the inner mucosa.

Apart from the stellate vessels with their bifurcations and anastomosing branches, the inner surface of the bladder at first sight appears singularly barren in landmarks, and the clinical observer finds it difficult either to convey to others an intelligent idea of lesions noted, or even to keep for himself an accurate record of the progress or decline of local disease. The female bladder is, however, most favorably situated for diagnosis *per speculum*, and it presents certain well-defined landmarks, so that the lack of a topography of its internal surface ought no longer to embarrass the practitioner.

I present the following schema as a preliminary study, which will, I hope, be found sufficient for present practical needs. My topography is based, it will be seen, upon a consideration of: 1. artificial landmarks; 2. natural landmarks; 3. the relation of the female bladder to surrounding structures.

Artificial Landmarks.—As I have already observed, the bladder under atmospheric distention appears to one peeping into it as a hollow sphere or ovoid. The two points, the internal orifice and that part of the posterior wall which is directly opposite to it, may be conveniently referred to as the *principal "polar points."*

The "*posterior pole*" is the point of departure in all examinations, because it is the first portion of the bladder seen as the light is reflected from the head mirror through the speculum turned directly backward. Any disease detected in its neighborhood may be de-

scribed as extending above or below or around it, or by the term "*circumpolar.*"

The posterior pole is a point around which inflammatory lesions are specially likely to be found; it should also be remembered that it is the part of the bladder most liable to trauma from friction with the edge of the speculum carried too far in. The circumpolar area may be conveniently considered as mapped out by three circles described around the pole as a centre, having radii respectively 1, 2, and 3 cm. in length. It is true that the posterior pole thus located is not a fixed point, but varies with different degrees of distention of the bladder, or with slight movements on the part of the speculum. In spite of this objection, however, the practical utility of the plan of registration proposed is greater than that of any other plan, and if a point is once fixed as the posterior pole, in any individual case, and a sketch made locating the patch of disease, the same locality is readily found on subsequent examination, as the point of departure for further measurements. One other fixed line in the bladder, always readily accessible in determining localization of diseases, is an imaginary line produced by sagittal section.

Affections situated about the anterior pole (ostium urethræ internum) are best described as circumurethral.

Proceeding another step in our differentiation, we will consider the bladder as divided into an *anterior* and a *posterior* hemisphere. The convenience of this division is especially apparent in describing affections of the posterior part of the bladder. Thus, if we imagine the posterior pole as a centre intersected at right angles by vertical and horizontal lines, the posterior hemisphere will be divided into four quadrants, a *right upper* and *lower quadrant*, and a *left upper* and *lower quadrant* (dexter superior and inferior, q. d. s. and q. d. i., and sinister superior and inferior, q. s. s. and q. s. i.). The position of the line in the plane of the sagittal suture cleaving the posterior hemisphere vertically is especially easy to determine by the eye, thus keeping right and left sides in the bladder sharply distinct in all its parts. With these purely artificial aids it is possible to locate precisely affections within the areas defined.

We may conveniently designate further an upper concave surface, or *vault*, of the bladder, and a floor, or *base*, as well as *right* and *left lateral walls*. These terms basal and apical, right and left lateral, may be reserved for affections located at the more central parts of these areas, near imaginary poles whose axes cross the bladder from side to side, and from top to bottom, at right angles to the first axis described.

Natural Landmarks.—In the anterior vesical hemisphere there

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Natural Landmarks.—In the anterior vesical hemisphere there

without the slightest resistance, discovering in this way an extreme relaxation due to coitus per urethram. The finger will also detect a rolling out of the urethra, a dropping of the bladder, or a prolapse in which the bladder forms part of the sac; sensitiveness of the base of the bladder, and more especially around its neck, may also be detected in this way. About half-way up the vagina, and curving out from the base of the bladder toward the posterior and lateral pelvic walls, in the direction of the cervix uteri, the finger will detect a flattened cord-like body which can be traced for about 10 cm. (4 in.) of its course, losing itself behind the cervix; this is the right or left ureter.

If the ureter cannot be readily felt and hooked down by the end of the finger in this way, it will be detected upon displacing the vaginal wall upward and outward until the end of the finger touches the lateral wall of the pelvis just below the superior strait. The finger is then drawn downward and backward, stroking the pelvic walls and carefully estimating the size and consistency of each structure touched. As soon as the observer thinks he has felt the ureter, he catches the cord again with the hooked finger, draws it down a little, and slides the finger along it toward the bladder, where it is felt leaving the pelvic wall, as it passes toward the base. It can be caught again and traced back until it loses itself alongside the cervix. About 8 cm. (3 in.) of the ureter can be felt in this way. It is never hard like a whipcord or a goose-quill, except under pathological conditions; it is rather a soft, flat, yielding band. In some cases, instead of lying close to the pelvic wall, it is farther out in the cellular tissue and is then not so easily felt with one hand.

In the later months of pregnancy, the ureter is often felt with remarkable distinctness against the head of the child. It appears then to be larger and of firmer consistency than at other times.

The examiner must avoid mistaking the upper margin of the levator ani muscle, the obturator nerve or artery, or the edge of the obturator foramen for the ureter.

That portion of the ureter which lies in the posterior part of the pelvis can often be felt from the rectum. It is particularly accessible to touch when enlarged by disease. The normal ureter can always be felt here when a bougie or catheter is introduced through the urethra into the ureter as far as the brim of the pelvis. The landmark in the rectum is the internal iliac artery, close to which the ureter lies on one side or the other during the first part of its course. By these means, it will be seen that the whole of the pelvic portion of the ureter is accessible to touch.

I have twice been able to palpate with perfect distinctness the

normal ureter through the abdominal walls, for a short distance upward from the brim of the pelvis. Both of these cases were women who had just been confined, and the abdominal walls were lax and the recti muscles separated. Not infrequently a ureter enlarged by disease can be detected as a round cord through the abdominal walls. Almost always in ureteral inflammatory disease, marked tenderness can be elicited on pressure at points about 3 cm. (1 in.) to the right and left of the promontory of the sacrum, which is first located by deep palpation. By a bimanual examination, with one or two fingers in the vagina, and one hand pressing down into the pelvis from above, the ureters can always be found, even when it has not been possible to locate them with one finger in the vagina as described. The object of the hand above is twofold, to displace the ureter slightly downward, making it more accessible to the vaginal finger, and to keep up an even pressure affording a plane of resistance against which the ureter can be palpated.

Another method of palpating the bladder, much in vogue in the early part of this century and up to within a few years ago, is the examination by means of a finger introduced into the bladder through the dilated urethra, or through an incision in the base of the bladder from the vagina. The details of this method need not be dwelt upon, as the perfect means of investigation now at our command enable us to dispense entirely with a procedure so distressing and fraught with ill consequences to the patient. Many of the victims of this mode of examination suffered afterward from a life-long incontinence.

Lastly, a mode of palpation of some value in a preliminary investigation is the sense of touch conveyed by a sound introduced into the bladder through the urethra, striking a stone or coming in contact with a tumor, or rugous surfaces of the bladder. Hemorrhage thus easily excited is significant of an inflammation or new growth.

3. *Inspection.*—But inspection is the method which yields the most immediate and positive results in examining the bladder and urethra for diagnostic purposes.

Inspection is able to teach us much about the bladder and urethra, even when confined to the external parts. By inspection of the external urethral orifice, we can determine its integrity or diseased condition, and in the latter case often see the mouths of the urethral tubules. Conditions of hyperæmia, inflammation, and caruncles are at once visible. Pus will sometimes be seen exuding from the urethral orifice. A displacement of the urethra downward and outward with the vaginal wall is evident. The displacement of the bladder together with the anterior vaginal wall, known as cystocele, and the

more marked displacement of a diverticulum of the bladder into a prolapsus sac, are also easily determined by inspection. The long ovoid, over-distended bladder pushing out the lower abdominal wall has a characteristic appearance. Since I propose to describe a new method of inspection which I consider superior to all its predecessors and free from their difficulties and dangers, I feel it necessary to premise my description with a brief consideration of the various other methods employed. I shall also show that by the same means by which we inspect the bladder and urethra, we are able to treat their affections topically.

For the inspection of the interior mucous surface of the bladder some seven methods, more or less widely differing from one another, have been proposed.

Professor G. Simon, of Heidelberg, examined the parts of the bladder which came into contact with the end of a straight speculum and covered its lumen. By sliding the speculum about, different parts of the bladder came into view. He estimates the value of endoscopy in these words: "The value of this procedure is much less than by palpation, as one can never illuminate more than a small area of the bladder, and thus only by chance discover papillary enlargements, ulcers, etc." As to the discovery of the ureteral orifics by such a means, he says, "Even with the magnesium light we have endeavored in vain to discover the ureteral orifice. Endoscopy is useful in illuminating all points that have been discovered by touch, and for the illumination of small areas is of great service in *the female*, as well as in the *male*."

Simon speaks of the practical results of his method of catheterizing the ureters in these terms: "As to the assurance of being able to introduce a sound or catheter—in my practice on corpses and the seventeen attempts on living subjects, I have not succeeded in perfecting my method to such an extent that I can feel confident of introducing the sound into the ureter at every sitting, but I believe I could do it in the majority of cases. I have had no opportunity to catheterize the ureter in disease."

Dr. Skene, of Brooklyn, examined the bladder through a speculum carrying a test-tube. Inside of this again a thin silver plate the length of the tube, and occupying about one-third of its circumference, was introduced. At the end of this plate a mirror was attached at an angle of about 100 degrees, and at the outer end a delicate handle projecting at an obtuse angle. By moving the mirror backward and forward and turning it around when the tube was introduced into the bladder and urethra, various portions of the mucous surface are brought into view, light being thrown into the tube by the

aid of a concave mirror. Skene sometimes used sunlight, but on account of its uncertainty preferred gaslight, taking his illumination from a gas-bracket having a universal movement.

Gruenfeld examined the bladder more satisfactorily than any of his predecessors, through a simple straight metal tube blackened on its inner surface, and with a pane of glass fixed obliquely at its vesical extremity. For the illumination, he employed a head-mirror with an electric light attached. He was enabled in this way to bring the ureter into view. He was also able to catheterize the ureter by passing a small catheter through the urethra into the bladder beside his endoscope. By inclining the endoscope to the proper angle, which he determined to be from 30 to 35 degrees, the ureteral orifice came into view, and the point of the catheter which was kept in front of the endoscope was engaged, the endoscope withdrawn, and the catheter pushed farther up into the ureter.

Another means of examination is that of Nitze, very generally used at present for examination and catheterization of the ureters in men. The source of illumination is here a little electric light at the extremity of the endoscope. The view of the inner surface of the bladder distended with water is transmitted by a telescopic arrangement to the eye of the observer at the outer end of the instrument. This complicated, delicate, but useful instrument has been used with equally great advantage in examining the female bladder.

Dr. Skene, the first American authority on this subject, says ("Treatise on Diseases of Women," New York, 1889, page 697): "The cystoscope of Nitze and Leiter is the only instrument for thoroughly investigating the bladder."

Rutenberg made a radical departure from both of the methods described by devising a speculum with a glass partition and a little tube, running down beside the speculum, attached to a rubber ball by which he puffed the bladder full of air. By means of a reflected light and a mirror attached to a handle, which could be pushed in and out and rotated, the various parts of the bladder wall were inspected. To use this instrument, it is necessary to dilate the urethra almost to a diameter of 2 cm. (¾ in.), which can only be done by anæsthetizing the patient. Professor Winckel of Munich speaks of this speculum with especial satisfaction.

My own method was first published in the *Johns Hopkins Hospital Bulletin*, for November, 1893, and in a longer and more fully illustrated article in the *American Journal of Obstetrics* for January, 1894. Its essential features are: 1, an atmospheric dilatation of the bladder induced by posture; 2, the introduction of a simple straight speculum without fenestra; 3, the examination of the mucous sur-

faces of the bladder and urethra by means of a light conveyed into the bladder.

This last and newest method is so important, promising as it does to clear up all the difficulties under which we have been laboring hitherto in the diagnosis of these affections, and to afford a simple and effective means of treatment, that I shall devote some space to a consideration of the exact method of making the examination and its various advantages.

The following instruments are required: A good light and a

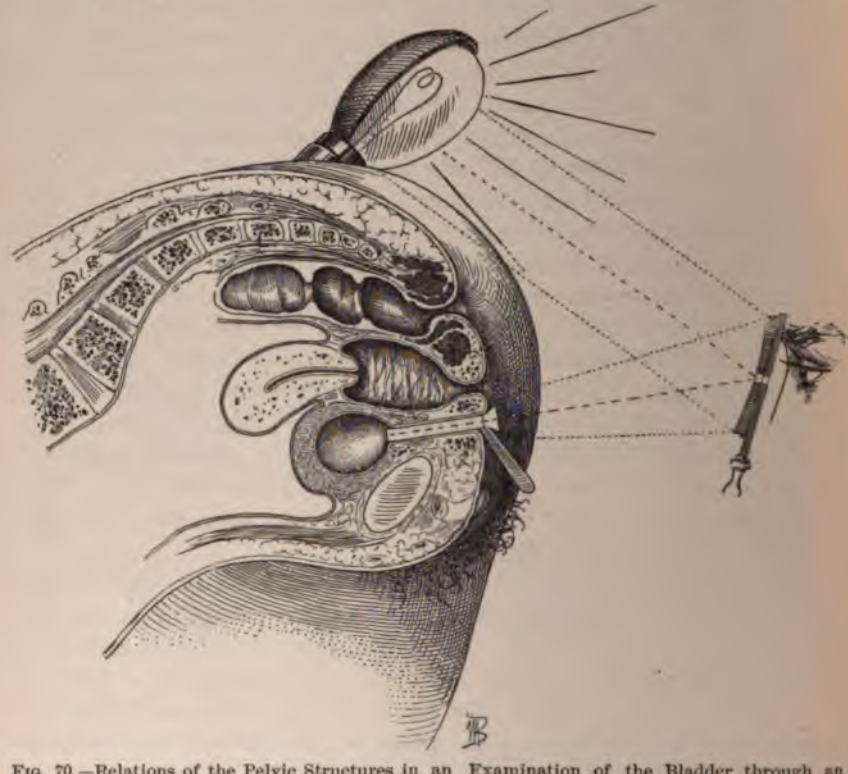

FIG. 70.—Relations of the Pelvic Structures in an Examination of the Bladder through an Open Speculum by a Reflected Light (Electric), under Atmospheric Dilatation. The speculum is too short and the bladder insufficiently dilated.

head-mirror; a urethral dilator; a speculum with an obturator (see Fig. 75); a suction apparatus to empty the bladder completely (see Fig. 79); a pair of long mouse-tooth forceps (see Fig. 80); a searcher for discovering the ureteral orifice (see Fig. 81).

A general anæsthetic is not necessary, unless the patient is so nervous that she will not submit to any kind of an examination. For this reason, it is sometimes of advantage to use ether or chloroform

during the first examination, which is apt to be more prolonged than the subsequent ones. If the urethra requires any dilatation, a drop of a ten-per-cent. solution of cocaine painted on its external orifice, or a piece of cotton wrapped on an applicator saturated with a four-per-cent. solution and laid just inside the orifice, will be sufficient to blunt the sensitiveness.

Immediately before examination the patient must pass water, preferably in the standing position. In spite of this effort to empty the bladder completely, a little residual urine almost always remains be-

FIG. 71.—Attitude of Patient with Elevated Pelvis, Dorsal Position, Ready for Introduction of Cystoscope and Examination of the Bladder under Atmospheric Dilatation.

hind. If the examination is delayed ten or fifteen minutes, five or ten cubic centimetres will be added.

The urethral orifice is now dilated by using a conical dilator (Fig. 82, 2), blunt at the point, 72 mm. long, and 16 mm. in diameter at the base and 4 mm. at the point. This is covered with vaseline and, with a screw-like movement, gently bored into the urethral orifice. Two or three gentle movements, holding the dilator poised between thumb and forefinger, will be sufficient to carry it in as far as the number 10 mark on the scale on its side. This indicates a dilatation of 1 cm. in diameter, sufficient for all ordinary purposes of investigation of the

bladder, treatment of its surfaces, and catheterization of the ureters. In many cases, particularly in women who have borne children, the orifice needs no dilatation to permit the introduction of a speculum of this size. The utmost damage done by the dilatation is a slight superficial injury to the mucous surface of the posterior margin of the urethra, which never requires attention.

I wish to call especial attention to the fact that dilatation of the external orifice of the urethra by a conical dilator alone is sufficient

FIG. 72.—Patient in Knee-Breast Position, Cystoscope Introduced. A sound shows position of anal orifice.

for the investigation. A series of dilators intended to dilate the whole canal may be discarded. The speculum is a simple metal cylinder 8 cm. (3 in.) long, of equal diameter from end to end, funnel-shaped at its outer end, and with a long handle that can be conveniently grasped in the full hand, and which is provided with an obturator. The diameters of the specula vary from 5 mm. up to 20 mm. ($\frac{1}{5}$ to $\frac{4}{5}$ in.), shown by Simon to be the safe outside limit. I have all sizes

made between these extremes, the successive numbers in the series differing 1 mm. in diameter. They are not conical like Simon's dilators. The sizes most useful are Nos. 8, 10, and 11. No. 8 (8 mm. in diameter) can be introduced into almost any urethra without preliminary dilatation, as it is scarcely larger than an ordinary catheter. This is the size which will be more frequently used by the practised examiner.

The patient may be examined either in the dorsal or knee-breast position. If in the dorsal position, she is placed on the table with legs

Fig. 73.—Posture of the Patient During Cystoscopy, more Convenient to the Examiner and often Yielding a Better Distention of the Bladder than with the Thighs Vertical.

and thighs well flexed, and hips elevated from 15 to 30 cm. (6 to 12 in.) above the level of the table. If she be a thin woman, when the speculum is introduced in this position, the air immediately rushes into the bladder, distending it. But this simple process will not succeed with a fat woman. The most convenient and universally applicable position is the knee-breast posture, with the chest as close to the table as possible, and the back well bent in. Frequently a more satisfactory posture is the knee-breast, with the patient squatting a little backward, so that the buttocks are in a position directly over the calves of the legs or the ankles, instead of being vertically over the thighs. The speculum is now taken in hand, as shown in the

illustration (Fig. 74), and held with the thumb firmly pressing upon the handle of the obturator. The urethral orifice is first well cleansed with a boric-acid solution. The point of the speculum is placed upon the orifice and pushed up through the urethra into the bladder in a direction describing a gentle curve around the under surface of the symphysis. As the speculum is being introduced, the vulva is held open with the other hand; in the case of a stout patient the buttocks are held widely apart by an assistant. On withdrawing the obturator, air rushes at once into the bladder, distending it with an audible suction sound. If it is undesirable or difficult to keep the patient in the knee-breast position, she may be gently turned to the dorsal position, taking care to keep the hips constantly ele-

FIG. 74.—Hand Holding Cystoscope in the Act of Introduction, Keeping Obturator Firmly Pressed in.

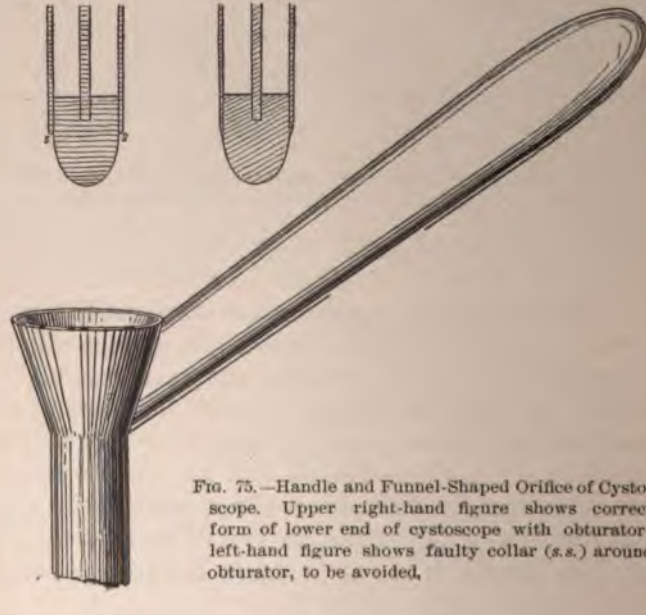

FIG. 75.—Handle and Funnel-Shaped Orifice of Cystoscope. Upper right-hand figure shows correct form of lower end of cystoscope with obturator; left-hand figure shows faulty collar (*s.s.*) around obturator, to be avoided.

vated above the level of the rest of the abdomen (Fig. 76). The intestines which have gravitated out of the pelvis will not return at all, or will return but slowly, so long as the hips are kept thus elevated.

It is well to place a pledget of cotton or a vessel beneath the mouth of the speculum to catch any urine driven out by forcible breathing, coughing, etc.

The examiner wears one of the ordinary head-mirrors used by the laryngoscopists, and by its means reflects a light from an electric lamp resting on a towel on the sacrum of the patient (if in the knee-breast

FIG. 76.—Cystoscopic Examination of Negress with Elevated Pelvis. Note electric light held just above the symphysis, head mirror, and cystoscope.

position), through the speculum, into the bladder. The illumination may also be derived from a small electric light attached in front of the mirror, or from a mignon lamp conveniently attached to the mouth of the speculum so as to throw its light into the bladder without interfering with the field of vision, as in the Otis urethroscope. I prefer, as the simplest and most easily attainable light, a common electric drop-light, with a short handle, connected with the bracket on the wall by a long cord. Where this is not attainable I take with me to the place of examination a small portable battery consisting of three storage cells. This is capable of running a mignon lamp for fifteen

hours consecutively. The only objection to this form of illumination is the expense of the outfit, and its liability to be out of order just when wanted for use. An Argand burner held by an assistant may be used, or a lamp or candle in case of necessity. Daylight will also sometimes be serviceable, but cannot of course be depended upon.

An important point to be borne in mind, in reflecting the light from its source into the bladder, is to make the angle formed by the pencil of light striking and leaving the mirror, as small as possible. The best arrangement from this standpoint is the little electric lamp held immediately in front of the reflector attached to the forehead, as shown in the figures. The electric light resting on the sacrum is for this reason far better than a lamp or candle, which must be held so as to make a considerable angle.

The first part seen is about the middle of the posterior wall. The groundwork of the bladder appears of a dull whitish color, everywhere divided up by a network of branching vessels. The inner vessels, almost like capillaries, can be traced to their trunks, and these again to larger trunks one or two millimetres in diameter, of a *dark or light red* color which seems to come up to the mucous surface from the deeper layers where the vessels lie hid from view. Occasionally an artery can be distinctly seen to pulsate. Sometimes little glistening points appear along the vessels. By elevating and depressing the handle of the speculum and moving it from side to side, all parts of the posterior hemisphere are brought successively into view. The size of the area viewed at any one time depends upon the calibre of the speculum, its closeness to the bladder wall, and the distance of the examining eye from the external opening. By markedly elevating the speculum the vault of the bladder is seen with the same distinctness. As a rule, the residual urine to the amount of 6 or 8 c.c. (1½ to 2 drachms) will have to be removed by the suction apparatus before all parts are brought into view. If the handle of the speculum is dropped a little the floor of the bladder will come into view. This is more or less in the plane of the eye of the observer, and must be examined with greater care to detect all the peculiarities of its surface. In order to bring special parts of the base more clearly into view, the speculum can be pushed until its edge rests upon the part, and then by dropping it a few millimetres and advancing it just a little, the area in question will be made to lie directly over the end of the speculum, at right angles to its former position.

The *trigonum* is brought into view by withdrawing the speculum until the internal urethral orifice just begins to close over it, and then pushing it in a little and dropping the handle slightly. This por-

tion of the bladder is as a rule a little more injected and rosy than the rest of the mucosa. The inter-ureteric ligament is sometimes marked as a distinct rounded transverse fold. By turning the speculum to the right or left about thirty degrees, with its end projecting 1 cm. into the bladder, the right and left ureteral orifices can be brought successively into view. The ureteral orifice usually appears as a little slit, about 3 mm. long, placed transversely with a slight horseshoe-shaped elevation around it, open on the inner side.

FIG. 77.—Cystoscopic Examination of Black Woman, with Elevated Pelvis, Dorsal Position. Introducing the searcher into the left ureteral orifice.

Usually, with the woman in the knee-breast position, the ureteral orifice is found on the inner side of a decided eminence, having the form of a truncated cone (mons ureteris). The ureteral orifice may at times appear as a little pit or hole in the mucosa, at other times as a rosette with the opening in the centre. If the observation is continued for a minute a little jet of urine will be seen to spurt out of the ureter for two or three seconds. The ureter then closes to be opened by another jet within the following minute. I have repeat-

edly seen pus or blood escaping from one ureter, while clear urine escaped from its fellow.

The ability to find the ureter readily is developed by practice. An experienced observer will introduce the speculum and turn it toward the side in question, and with one or two slight movements of adjustment, pushing it, withdrawing it, or turning it a little, will have the ureteral orifice within the field of vision within two or three seconds.

Occasionally the bladder presents some little depression which the examiner cannot be sure is not the ureteral orifice. The doubt may be readily settled by taking up the searcher, which has a strongly curved handle, keeping it out of the field of vision, and introducing its point into the opening. If it is the ureter, the searcher will pass readily 3, 4, or even 6 or 8 cm. (1, 1½, 2, or 3 in.). I have not noticed any special sensitiveness about the ureteral orifice.

In the virgin, it may be difficult to find the ureteral orifices, owing to the fact that the bladder balloons out too much, carrying the base high up toward the sacrum. To gain even an unsatisfactory view under these circumstances, the observer has to get his head almost under the patient's body. This difficulty will be overcome by taking the precaution beforehand to introduce a speculum into the vagina, in order to distend it with air. This prevents the excessive distention of the bladder in this direction.

That portion of the bladder which lies behind the symphysis may be inspected by elevating the handle of the speculum very decidedly and looking down toward the anterior part of the vault.

Sounding and Catheterizing the Female Ureters.

The passage of a catheter, sound, or bougie into the ureter is as easily accomplished as the inspection of its orifice, and, if gently conducted, is a simple, painless, and harmless procedure. I have found it necessary under a variety of conditions, the most important of which may be classified under the following headings:

First, for the collection of urine directly from the ureter, without contamination with the bladder, in order to determine the presence or absence of renal disease, or of one kidney and not of the other.

Second, to determine the existence of ureteral disease, such as hydro-ureter and pyo-ureter.

Third, in order to lay a solid bougie in the ureter, so that it can be kept constantly under touch and recognized throughout any abdominal or pelvic operation in which it was in danger of being cut or tied.

For a ureteral catheter, I use a simple metal tube about 25 cm. (10 in.) long, gently curved at its outer end, which is held in the hand, so as not to obstruct the view during its introduction. The end is also enlarged a little, so as to hold a fine rubber tube slipped over it in washing out the ureter and kidney. The ureteral end of the catheter has a rounded point with three or four holes in it, and a very slight curve at the end.

To introduce the catheter, the ureteral orifice is brought to about the centre of the field of the speculum, and the mirror and light are

FIG. 78.—Catheterizing the Ureter. The case illustrated was one of hydro-ureter in which there was a stricture of the left ureter. The ureteral catheter passed the stricture and 100 c.c. of urine were drawn off in less time than 3 c.c. would be collected under normal conditions.

adjusted so that the head of the observer is not in the way as he introduces the catheter into the speculum and slides it on, until its point rests in the ureteral slit. On pushing it in a little, the sides of the opening separate, and it appears as a hole, with the catheter lying in one side of it. The catheter must now be pushed out gently toward the side, stopping at once if the slightest resistance or obstruction is met. When it has reached the pelvic wall, 4 or 5 cm. (1½ to 2 in.) from the orifice, it must be firmly held while the speculum is slowly drawn out, disengaged from the urethra, and pulled over its end. It is usually necessary for an assistant to pull open the buttock of the

side on which the handle lies, to keep it from making such undue pressure upon the ureteral catheter as may injure the ureter. The patient who has been in the knee-breast position may now raise herself up on her elbows or hands, while the urine is being collected as it flows from the catheter. A minute or two, or more, often elapses before the flow begins. It is easy to tell whether the catheter is filling by stopping up its end with a little drop of water, which blows out in the form of a little bubble as soon as there is any movement within. The urine escapes intermittently by three, four, or five drops, one after the other, followed by a pause of from a few seconds to a half-minute or more. The average amount of the flow should be a half cubic centimetre (½ drachm) per minute. It is often less than this, but rarely more, unless there is some disease. I have in a number of instances seen the urine escape from the catheter in a steady stream, but they were all cases of hydro-ureter.

For a prolonged drainage of the ureter, or in order to drain both ureters, permitting no urine whatever to enter the bladder, it is necessary to introduce two short ureteral catheters, with fine rubber tubing on the ends, in the following manner: The catheters are about 6 cm. long (2½ in.) and 2 mm. ($\frac{1}{10}$ in.) in diameter, slightly curved, and with holes in the end, like the ureteral catheter just described. The outer end of the catheter is a little enlarged, and over it is passed a piece of fine rubber tubing about 15 cm. (6 in.) long. A stylet with a strongly bent handle is coated with vaseline and introduced into the catheter through the tube. This gives the requisite stiffness and length for the introduction of the catheter into the ureter after the manner previously described. The catheter is pushed well on until its outer end lies within the bladder 1 or 2 cm. (½ to 1 in.) from the ureteral orifice. The stylet is now withdrawn, and after it the speculum, very slowly, taking care not to drag the rubber tubing with it. The speculum is again dipped in sterilized vaseline, and re-entered into the bladder, beside the rubber tube. The opposite ureter is now exposed and catheterized in like manner and the speculum again withdrawn. The rubber tubes now lie in the vulvar cleft emerging from the urethra, conveying the urine from right and left kidney into separate vessels. Care must be taken to mark the tubes, distinguishing right from left.

I have also been able to catheterize both ureters in this way without withdrawing the speculum, by catheterizing one first and pushing several centimetres of its rubber tube into the bladder so that it would not be pulled upon, while turning the speculum to the opposite side to catheterize the other ureter.

I have had flexible bougies made 2½ mm. ($\frac{1}{10}$ in.) in diameter and

40 mm. (1½ in.) in length with well-rounded ends. These are kept cool so as to be stiff when wanted for use. If too flexible they cannot be introduced into the ureter. The bougie is inserted into the ureter by passing it along the tube, which is elevated until the end of the bougie lies in the urethral orifice. The bougie is then slowly pushed on 2 or 3 cm. (1 to 1½ in.) at a time, grasping it close to the speculum. There is no difficulty in this manner in carrying it all the way up to the kidney.

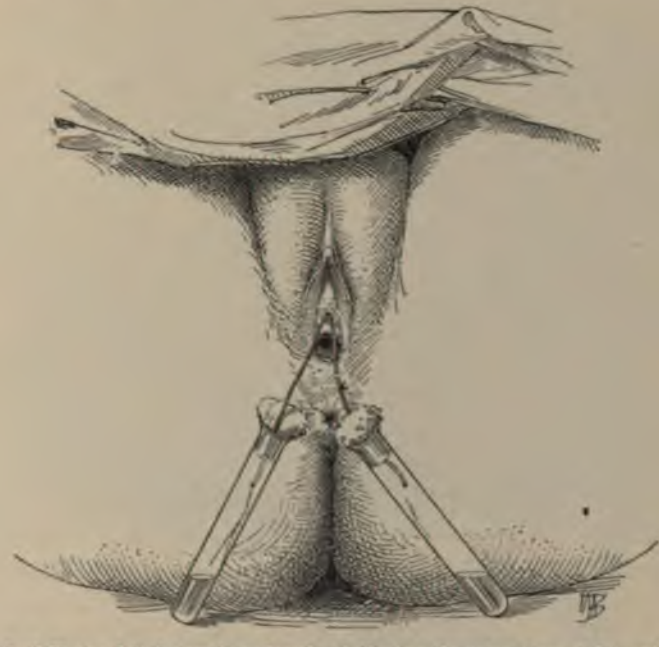

FIG. 79.—Both Ureteral Catheters Introduced. Collecting the urine from right and left side separately in sterile tubes. The short metal catheters lie wholly inside and are connected with the test tubes by fine rubber tubing, as shown.

Catheterization of the Ureters without Elevation of the Pelvis and without Distention of the Bladder.

It is sometimes inconvenient to elevate the hips of the patient, especially if the purpose of exposing the ureteral orifice is only to push in a bougie, in order that the ureter may be distinctly felt throughout a pelvic operation. An experienced observer in such cases will usually be able to locate the ureteral orifice in the following manner. The bladder is emptied as completely as possible by a catheter, the vesical speculum introduced, and its point turned in the direction in which the ureter is supposed to lie. The light is

now directed into the bladder and its wall carefully inspected, as the speculum slowly slides over the ureteral area. It is necessary throughout to keep the speculum in close contact with the mucous surface of the bladder to prevent the urine from running in and covering the field of vision. Such urine as does accumulate from time to time must be removed with a suction apparatus, or a little pledget of cotton. I have catheterized ureters in this way a number of times before doing a vaginal hysterectomy.

FIG. 80.—Hard-rubber Bougies Introduced High Up into Both Ureters to Facilitate Hysterectomy for Carcinoma of the Cervix.

A Method of Securing Urine from the Ureters without Catheterization.

I desire now to speak briefly of a novel development of my method of examining the bladder and exposing the ureteral orifices, that is, the securing of urine direct from the ureter, without passing over the surface of the bladder and at the same time without introducing a catheter.

Oftentimes it will be deemed inadvisable to catheterize the ureters, in cases in which the bladder is inflamed or contains infectious material, on account of the danger of conveying the disease on the point of the catheter from the bladder to the ureter, producing pyoureter, pyelitis, and pyelonephrosis. In these cases I have been able to dispense with the catheterization of the ureter and gather a small quantity of urine by a very simple device.

It is evident that for the purpose of urinalysis, obtaining specific gravity, and making microscopic and bacteriological examinations, a few drops of urine is as serviceable as a large quantity. When the difference is marked between the urine from the two sides this demonstration is particularly satisfactory. Two methods may be employed: in one the patient is placed in the knee-breast position, in the second she lies in the dorsal position without elevation of the hips.

To examine the patient in the knee-breast position, the only special instrument needed is a speculum, a centimetre longer than the ordinary, and cut off obliquely at the end. The ureteral orifice is found as described, and carefully cleansed with a small pledget of cotton, saturated with a warm boric acid solution, applied by means of mouse-tooth forceps. The orifice of the speculum is now pressed gently up against the bladder wall so as to bring the ureteral orifice about in its centre. This gentle pressure is kept up for five or ten minutes, during which time all the urine escaping from the ureter runs directly into the speculum and down its sides to the outer edge, where it is either allowed to drop into a small graduated glass, or is taken up with a bit of cotton and squeezed into a little sieve, through which a drop or two of urine is expressed out of the cotton into the glass below. This is reserved for the examination. If the other side is to be examined in the same way, the speculum must be cleansed and re-introduced, and the urine collected after cleansing the area around the ureter. When the secretion of urine is active—I have seen it spurting in jets—it will only be necessary to hold the speculum up under the ureteral orifice without touching the bladder wall, in order to catch all that will be required for the examination.

FIG. 81.—Evacuator for Completely Emptying the Bladder of its Urine after Introducing the Speculum.

FIG. 83.—Long, Delicate Mouse-tooth Forceps, with Slightly Recurved Teeth for Conveying Small Pledgets of Cotton into the Urethra and Bladder through the Speculum.

To secure urine from the patient in the dorsal position, without catheterization, the bladder is emptied of urine as completely as possible with the catheter. Then the ordinary No. 10 speculum is introduced and the ureteral orifice sought by sliding the speculum over the bladder wall, making sufficient pressure to keep out the residual urine in the bladder. When the orifice is found, the speculum is pressed gently down on the mucosa, which is carefully cleansed with a pledget of cotton. The urine then appears in little jets at intervals, and is taken up on a small pledget of cotton. If the patient be thin, and the hips elevated in the dorsal position, the examination will not be impeded by the residual urine from the bladder working in under the edges of the speculum.

WASHING OUT THE URETERS AND PELVES OF THE KIDNEYS.

I shall notice briefly, as but indirectly pertaining to my subject, one of the most important developments of this method of investigation. I have found that by means of the catheter introduced into the ureter, connected by a long, delicate rubber tube with a funnel, I am able with ease to wash out the urinary tract up to and including the pelvis of the kidney. The cases in which I have been called upon to do this have been cases of hydro-ureter with stricture at the vesical end of the ureter, and of pyoureter with pyelitis, also with stricture at the lower extremity, and one case of colon-bacillus infection of the right ureter and pelvis. The patient is put in the knee-breast position, and the catheter, with a short piece of rubber tubing attached, is filled with a saline or boric acid solution, and clamped to keep the solution from running out. The catheter is now introduced into the ureter at least 5 or 6 cm. (2 or 3 in.) and the speculum withdrawn. A funnel or graduated tube

FIG. 83.—Various Instruments Used in Ureteral and Bladder Work. 1, Long speculum cut obliquely at the end to press up over ureteral orifice and catch the urine, with the patient in the knee-breast position, without catheterizing the ureter; 2, short conical dilator used in enlarging urethral orifice for the introduction of the speculum; 3, short catheter with rubber tubing attached. The catheter is introduced into the ureter and left there while collecting the urine through the tube in a receptacle between the thighs; 4, searcher for testing ureteral orifices; 5 *a*, upper and lower ends of ordinary ureteral catheter; 5 *b*, *c*, *d*, the upper ends of a series of dilating catheters used as bougies in dilating stricture of the ureter.

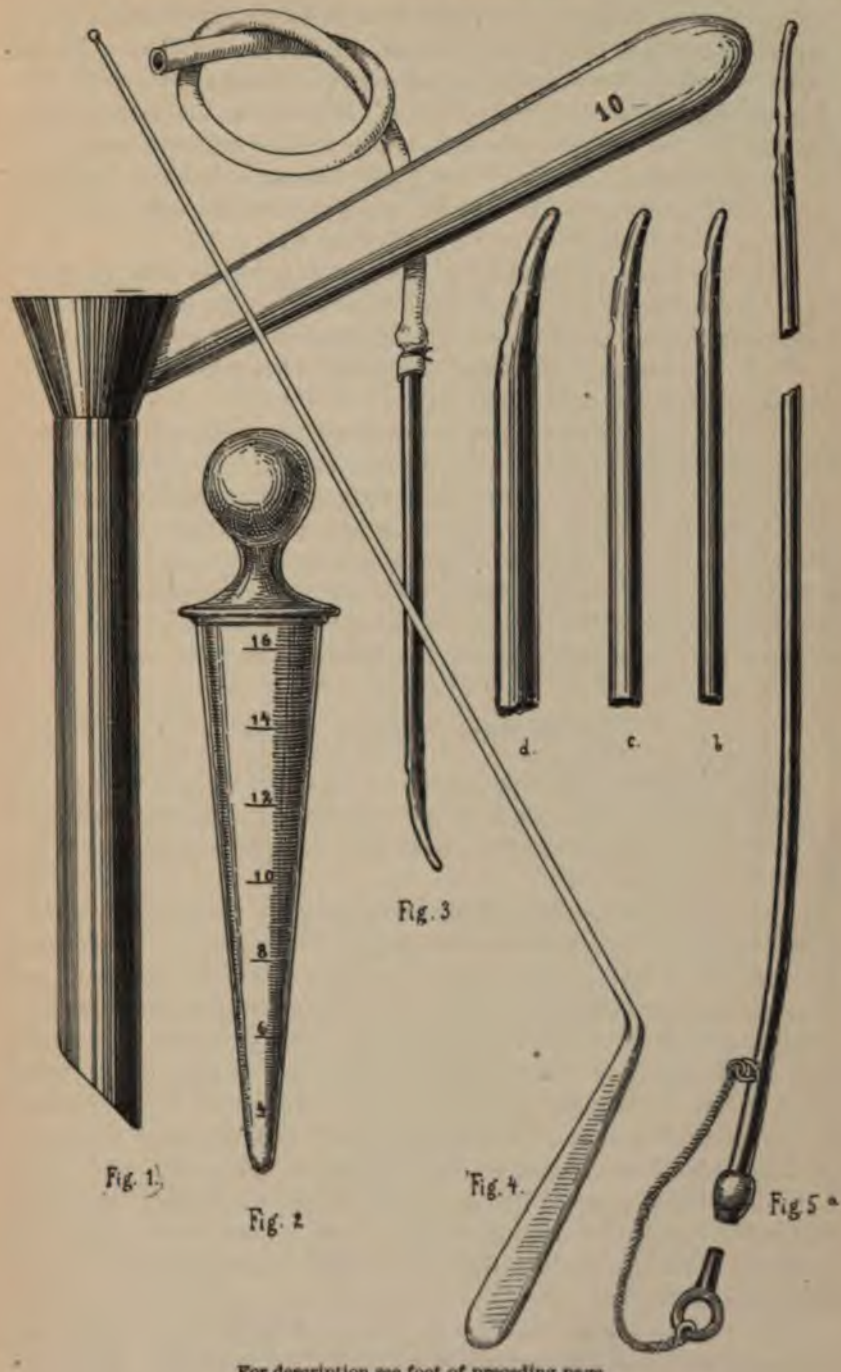

Fig. 1. Fig. 2. Fig. 3. Fig. 4. Fig. 5.

For description see foot of preceding page.

with a piece of rubber tubing about 30 to 40 cm. (12 to 16 in.) long, having attached to it a glass point drawn sufficiently fine to allow of its introduction into the tube on the catheter, is now filled with solution and connected with the catheter. By raising the funnel above the level of the body, the fluid is made to flow into the ureter and up into the kidney; by dropping it well below the level of the body, it runs out again. In this way the fluid can be made to run in and out at will, or fresh fluid can be used each time.

The procedure is painless to the patient, who is able, however, from a little discomfort in the renal region to guide the operator in estimating when a proper amount of distention has been reached.

When the ureter is distended by pus or urine, this must be withdrawn before running in the fluid.

One urgent word of caution is necessary regarding all these ureteral manipulations, and it applies with especial force to the cases in which infection already exists. It is the constant necessity for painstaking care in making the manipulations gentle throughout. Any roughness or pushing past obstructions, or endeavors to push the catheter up higher than it will readily go, will quite certainly injure the mucous coat of the ureter, and be apt to be followed by a sharp chill and fever, persisting from a few hours to several days.

Examination of the Urethra.

After completing the examination of the bladder and ureters, the urethra is examined throughout its whole extent, beginning with the internal orifice, and proceeding out to the external one, as the speculum is slowly withdrawn.

As soon as the speculum leaves the lumen of the bladder, the internal urethral orifice is seen projecting over the edge on all sides, in the form of a fine ring. Upon withdrawing the speculum a little farther the ring increases in breadth, contracting, as the speculum continues to be withdrawn, in a circular, oval, or trapezoidal form. Just as the lumen is about to disappear by the meeting of the walls on all sides, it looks like a small pinhole, or a little oval, 2 or 3 mm. in diameter; it is not a slit as stated by so many writers.

Throughout the length of the urethra, the funnel-shaped figure formed by the mucous folds converging from the edges of the speculum to the centre of the canal is made up of a number of plicæ, 1 or 2 mm. in diameter, usually showing distinct vessels running parallel with the canal.

The color is a deep rose or red, not as intense as in the male. At both extremities, within a centimetre of the internal and external os,

groups of glands and tits are seen as points or little yellowish spots on the mucosa. They are found more abundantly on the vaginal side to the right or left of the median line. These are the crypts or pits and the acinous glands.

Just as the speculum is about to escape entirely from the urethra, the mucous surface becomes pale and the orifices of Skene's tubules come into view, appearing as darkish points about 1 mm. in diameter.

Asepsis in Urethral, Vesical, and Ureteral Examinations.

Examples of general septic infection starting in the lower urinary tract and travelling up, infecting bladder, ureter, renal pelvis, and kidney, and from thence the system at large, are sufficiently abundant in medical literature to require no demonstration here to prove the possibility of such an accident. In the male, the ascending cases of gonorrhœa and the cystitis and pyelitis following the introduction of a catheter, are the most familiar examples, while in the female the occasional outbursts of cystitis in the gynecological and obstetrical wards are unquestionably due to septic catheters. I remember, when I was a resident in a large general hospital, a man with a broken back whose urethra was literally torn to pieces by the repeated introduction of a flexible catheter from which the shellac coating was peeling off in thousands of little flinty, jagged scales, all over its surface. The consequence was an intense purulent urethritis, cystitis, and death.

In the same way one catheter in careless hands in an obstetric ward has repeatedly been the means of infecting one patient after another.

Too great care cannot therefore be taken in observing rigid aseptic rules throughout the manipulations necessary for the investigation of the urinary tract.

The instruments must be thoroughly washed with hot water and soap after every investigation, and in inflammatory and infected cases, the dilators, cystoscopes with obturators, searcher, catheters, and evacuator, must be boiled in a one-per-cent soda solution, and then preferably laid away between sterilized towels. The hands of the operator and his assistants must under no circumstances come directly into contact with those portions of the examining instruments which are introduced into the urethra and bladder. There is no necessity for manual touching of the end of the cystoscope, the searcher, the ureteral catheter, or the little sterilized pledgets of cotton with which the residual urine is taken out of the bladder.

The urethral orifice must always be carefully cleansed before

a speculum is introduced, and if the case is one of gonorrhœal infection it will be safer first to empty Skene's glands, removing any pus they may contain. If there is any acute inflammatory trouble in the urethra there will be some danger of carrying up septic material into the bladder in pushing in the speculum. This ought, therefore, not to be done without first washing out the urethra with a short catheter so constructed that the water passing out at the point is directed backward into a tube a short distance behind it and thus allowed to escape. If there is any inflammatory trouble in the bladder the ureteral orifice ought first to be wiped off with a saturated boric acid solution before passing in the ureteral catheter.

In severe catarrhal diseases of the bladder catheters should not be left in the ureters to drain off the urine for any considerable time unless an urgent necessity exists.

Estimate of the Value of this Method of Examination.—The procedure described above presents many points of advantage over other means of examining these organs. In the first place, we are enabled, by means of a speculum 8 to 10 mm. in diameter, to examine all parts of the bladder and ureteral orifices without anæsthesia, without pain, and without injury to the urethra.

This method is analogous to the investigation of the posterior pharynx, with a reflected light and tongue depressor, and quite as simple. It is more direct than the examination of the larynx or the eye. It has, however, much in common with ophthalmoscopy, being the examination of the inner surface of a spherical body through a circular opening in one of its sides. It has a material advantage over ophthalmoscopy in that we are able to see all parts of the sphere equally well, even those lying anteriorly near the opening. We have also here the further advantage of being able to investigate the condition of distant organs such as the ureters and kidneys. An analogous condition in eye diseases would be the power to examine the optic tracts in the brain and draw important conclusions as to brain disease.

We also possess a certainty in diagnosis, and a large number of affections hitherto not recognized are brought within the reach of topical treatment. I have found, for example, that affections which were wont to be considered general diseases involving all parts of the bladder mucosa may in reality involve only a small part, or are often distributed in patches with intervening healthy parts.

I have found also that so-called irritable bladder in women is a mild inflammatory affection involving either a small part of the trigonum or a part of the urethra, and is a disease readily amenable to treatment.

The method does away forever with the incision of the bladder for diagnostic purposes, or the incision and dilatation of the urethra for the purpose of introducing the finger into the bladder.

By catheterizing the ureters in the simple manner described we do away with the necessity of fishing for them with a catheter introduced through the urethra, guided by the eye watching its point playing over the anterior vaginal wall. This method of Pawlik is always more or less uncertain, is quite difficult, and attended with injury to the bladder, and in inflammatory cases is particularly dangerous.

We can by this means exclude renal disease where pus is found in the urine, or we can diagnose unilateral or bilateral renal disease.

We can also always readily ascertain the sources of hemorrhage.

We are thus enabled to treat pyelitis and pyo-ureter and stricture of the ureter in its lower part.

Treatment can be applied directly to the parts affected without unnecessarily treating the sound surfaces.

We may also follow up the method of treatment from week to week without discomfort to the patient, and with certainty as to results.

DISEASES OF THE URETHRA.

Diseases of the urethra in the female often escape the attention of gynecologists, either because of the difficulties of the examination, instruments different from those with which they are most familiar being required, or because these diseases are so often found so associated with other grave genital affections that the urethral disturbance is liable to be passed over as secondary, or, if noticed at all, to receive inadequate attention.

I propose to speak of the diseases of the urethra under the following heads: (1) Malformations; (2) Displacements; (3) Variations in calibre; (4) Fistulæ; (5) Inflammatory diseases; (6) New growths.

Malformations.

Commonest of all malformations of the urethra is a marked lateral displacement or obliquity of the external orifice. When the urethral orifice appears distinctly on one side, there is apt to be a shallow vertical fissure at a corresponding point on the opposite side, with a ridge between the two, appearing to indicate an early embryonic double urethra.

Other malformations are due to failure in the development of some portion of the urethral wall in embryonic life. These are

called, accordingly as the defective part is the external or internal portion of the urethra, *defectus urethræ externus* and *defectus urethræ internus*. If the whole urethra is wanting, the anomaly is described as *defectus urethræ totalis*. If a portion of the anterior inferior wall is absent, the condition is one of *hypospadias*.

These anomalies of the urethra are as a rule associated with other anomalies of the external and internal genital organs.

Defectus Urethræ Totalis.—In total absence of the urethra its rudiments are invisible externally, and the opening for the discharge of the urine exists in the form of a slit in the base of the bladder. In a case of Langenbeck's, cited by Winckel, a girl of nineteen had an imperforate hymen, the urethra was absent, and vagina and bladder formed a common canal.

Atresia of the Urethra.—In this case, the urethra is open as far as the bladder, which is closed and together with the ureters dilated. Schatz has reported a case in which the urethra ended in a cul-de-sac 5 mm. long. The rest of the urinary apparatus and the internal genitals were completely divided into right and left, and the bladders opened into the vagina through congenital vesico-vaginal fistulæ.

Hypospadias.—In hypospadias, the anterior and some of the lateral urethral walls are present and indicated by a furrow, while the inferior wall is absent from the external orifice to a greater or less extent backward; the urethra thus opens well within the vagina. In one instance of this kind, in the case of a woman forty-six years old, the common urinary and vaginal orifice lay small and contracted underneath the symphysis. A half an inch farther in, it was divided into three passages, the anterior being the urethra, which was an inch long, and the posterior a double vagina nearly three inches long.

Many of these affections do not call for treatment, being either anomalies occasioning death in fœtal life, as in the case of atresia, or associated with other serious malformations of the external genitals.

Mandl has reported a case (*Wiener klinische Wochenschrift*, 1891, page 515), of retention of urine for two days in a child, with a congenital atresia; the retention was accompanied by vomiting and convulsions. The atresia was broken through by passing a sound into the bladder, and the symptoms were entirely relieved.

Displacements of the Urethra.

There are in general four forms of displacement of the urethra: (1) Displacement upward; (2) Moderate downward displacement. (3) Complete displacement of the whole urethra downward; (4) Prolapse of the mucous membrane of the urethra at the external orifice.

Upward displacement is seen in association with pelvic tumors, more particularly large myomata lifting the uterus up into the abdominal cavity, and pulling along with it both bladder and urethra. In these cases the urethra may be so drawn up and flattened by compression between the tumor and the symphysis as to make the passage of the catheter both difficult and dangerous. A similar difficulty is often experienced in catheterizing during labor, when the head of the child is well engaged in the pelvis. I know of an instance in which the doctor, not appreciating this difference in the direction of the urethra in the parturient woman, in his efforts to draw off the urine before performing a Cæsarean section, perforated the posterior wall of the urethra with the catheter and even forced the latter into the child's head several times, bringing away some of the brain in the eye of the instrument. The operation was not performed, and the woman passed a dead child with several small holes in its head.

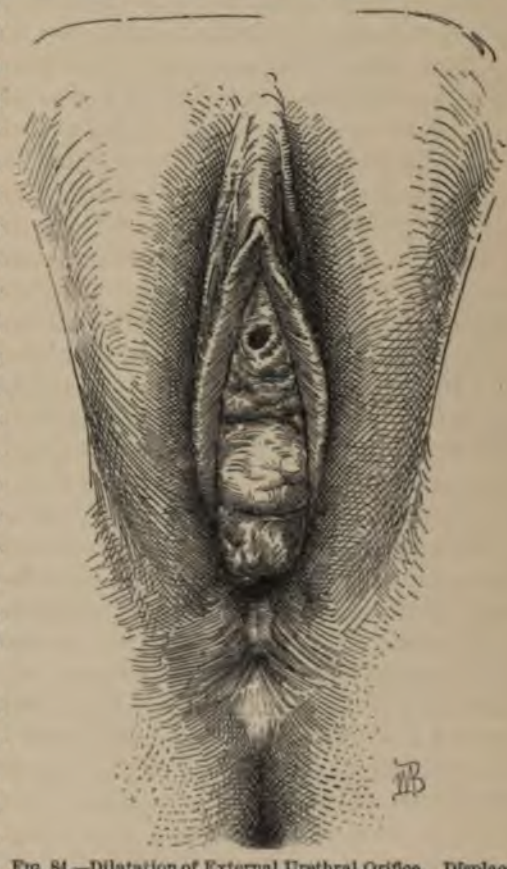

FIG. 84.—Dilatation of External Urethral Orifice. Displacement of urethra and bladder associated with complete tear

This displacement will be relieved when the tumor has been removed, letting the bladder and urethra down to their normal relations within the pelvis.

A moderate downward displacement is found associated with a descensus uteri and a dropping of the anterior vaginal wall and the formation of a cystocele.

Complete downward displacement of the urethra occurs commonly with a prolapsus uteri. The direction of the urethra in these cases is at right angles to its former position. Owing to this extreme displacement, which removes the urethra from the line of effective intra-

abdominal pressure, as well as from its relation to the diverticulum of the bladder, the difficulty of emptying the bladder in prolapse is very great and considerable urine is almost always left behind.

This difficulty is corrected by the appropriate operation for the prolapsus, restoring the organs to their normal position.

Prolapse of the mucous membrane of the urethra is a disease more common at the extremes of life.. It has thus been noticed in little children a few months or a few years old, and in women of from forty-five to sixty years of age and over.

In the case of women it is usually an eversion of that part of the mucous membrane lying adjacent to the external orifice. It forms in these cases an intensely red, highly vascular tumor, in the centre or to one side of which the urethral canal is found. In one case observed by Bagot in a woman aged thirty-two, the extruded part became gangrenous and sloughed off.

In little children, on the contrary, the relaxation of the mucous membrane and the *eversion* take place from within outward. The tumor appears at the external orifice and may project an inch or more beyond it, being swollen, deep-red or bluish-red, sometimes bathed in pus. It has been noticed as a sequence of severe coughing in whooping-cough, or straining at stool in diarrhœa, and following the injury produced by rape. Weak, anæmic, and scrofulous children are most liable to it.

The treatment should not be by galvano-cautery, on account of the danger of contraction and stricture of the urethra, and it is of no use to replace the tumor, for it will invariably be reproduced. The treatment which has been adopted with the most success has been the union of the neck of the tumor with the margin of the urethra on all sides, by interrupted fine silk sutures. Care must be taken to pass the suture before cutting away the tumor, lest the severed mucous membrane retract within the urethra and bleed indefinitely before it can be secured again. It is best to leave a catheter in the bladder for two or three days.

Variations in Calibre.

Variations in calibre of three kinds are found in the urethra: (1) stricture; (2) general dilatation; (3) partial dilatation.

Stricture.

Strictures of the urethra are usually circular or tubular and result from an antecedent gonorrhœa. Stricture may also result from trauma. I have seen one case of carcinoma in which the urethra

was narrowed throughout its length by a longitudinal infiltration parallel to the canal. Marked narrowing of the urethra is also not uncommonly observed when carcinoma involves the urethro-vaginal septum.

Van de Warker lays great stress upon strictures of the urethra of larger calibre, comparing them to these strictures in the male. Indeed he thinks they are more frequent than in the male, and result either from gonorrhœa or from trauma in childbirth. They are more rare in young women. These strictures are not to be detected by an ordinary sound. The best way to detect their presence is by passing an olive-pointed bougie which trips over the ring of the stricture as it is withdrawn.

The *diagnosis* of stricture of small calibre is often made accidentally in the difficulty experienced by the first attempt to catheterize the patient. In one of my cases, in which I performed a cholecystotomy, I was able only with difficulty to introduce a catheter 2 mm. in diameter through a stricture which lay immediately behind the meatus. In another case suffering from extensive ulceration of the external genitals and elephantiasis, the lower part of the urethra was converted into a rigid tubular canal.

Upon introducing the speculum the contracted lumen of the strictured urethra is seen closing over in front of the orifice of the speculum, which cannot be pushed any farther in without undue force.

Treatment.—This consists in dilatation by graduated bougies, which is usually not difficult, on account of the shortness of the canal making the stricture easily accessible. The best dilators are slightly sigmoid in shape, the sizes increasing a half-millimeter each time from 3 mm. up to 12 mm. At one treatment sufficient dilatation, from 2 to 5 or 6 mm., can be obtained to allow the urine to pass readily. At the subsequent treatments, the dilatation can be carried up to 8 or 10 mm., at which point it must be maintained.

For the first thorough examination it is best to give anæsthesia, and afterward to continue the dilatations under cocaine.

It is important to keep these cases under observation a long time, because a stricture which has been dilated shows a persistent tendency to contract again. In one of my cases I had a dilator made the size of one of my No. 8 endoscopes, that is, 8 mm. in diameter, and taught the patient to pass it herself. I saw her a year later and learned that by using the dilator at intervals she had had no further difficulty.

Where the injury to the anterior part of the urethra is extensive and associated with a large amount of cicatricial tissue, it will be better to buttonhole the urethra behind the stricture, by incising the ure-

thro-vaginal septum, taking care not to touch the neck of the bladder by keeping as far anterior to it as the stricture permits, and attaching the mucous membrane of the urethra on all sides to the mucous membrane of the vagina.

General Dilatation.

Relaxation of the urethra as a whole is most frequently observed in cases where coitus has taken place per urethram, or where the urethra has been dilated by the finger for the examination of the bladder, or for the extraction of a stone. Cases of relaxation due to the latter cause are fortunately becoming rare, and ought never to occur.

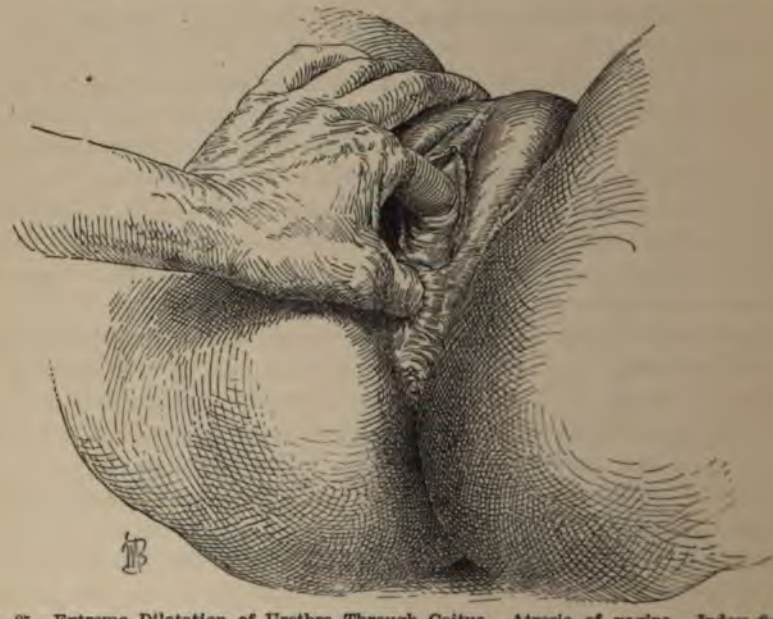

Fig. 85.—Extreme Dilatation of Urethra Through Coitus. Atresia of vagina. Index finger introduced into the bladder, thumb in the rectum.

Relaxation due to coitus per urethram is found in cases of malformation of the external genitals interfering with coitus per vaginam, as in the case of imperforate hymen, or absence of the vagina. I saw an extreme case of relaxation of this form in one of my cases, in which the urethra lay inside the vaginal orifice behind the symphysis pubis, and below it were two small orifices divided by the septum; it was a case of double vagina, so placed as not to be infringed upon by any large body introduced from without.

Another class of cases is that in which atresia has been acquired through inflammatory affections following childbirth; thus in the

patient figured in the text, a black woman, the vagina was closed down to a fine fistulous orifice about the size of a hair. The only trace of the vagina left below the atresia was a little pocket. Above was a large hæmatokolpos and hæmatometra. The urethra was so relaxed that in examining the patient the index finger passed at once into the bladder without the examiner being conscious of the abnormal condition. When the patient was anæsthetized two fingers could easily be carried into the bladder.

The symptoms produced by this condition are variable. Where the urethra has been broken down by an examination or by dragging out a stone, persistent incontinence may be the result, the patient having no power to control the flow of urine, which dribbles continually over her person. In relaxations from coitus, strange to say, the patients are not usually troubled with incontinence, being able to hold the urine two or three hours. But it usually escapes when the woman laughs or during the strain of sudden lifting.

Treatment.—When the relaxation is due to coitus, it will be best not to touch it unless the vaginal canal can be restored. In the case of the black woman above referred to, the urethra was relieved of its abnormal function by an operation establishing the integrity of the vaginal canal. The case of relaxed urethra with double vagina was relieved by a plastic operation bringing the lower margin of the urethra farther forward, and by cutting away the septum between the two halves of the vagina, substituting a single larger for two smaller functionally useless canals.

Where the incontinence is due to manual or instrumental breaking down of the canal, Schultze has recommended an operation to restore the urethra with the neck of the bladder to its normal calibre, by first splitting the vaginal mucosa over the urethra and then drawing out the excess of the dilated canal and cutting it off with sharp scissors, uniting the raw surfaces again by suture.

Winckel treated a case by excision of a piece of the anterior vaginal wall 8 cm. (3 in.) long, and from 1 to 1½ cm. (½ to ¾ in.) in breadth, beginning at the very margin of the urethra. The wounded surface thus exposed was closed with twelve silkworm-gut sutures. He did this at first without removing any of the mucous membrane, and the improvement was but moderate. At a second operation a piece 2½ cm. long by 1½ cm. broad was excised, including a piece of the mucous membrane of the urethra from 4 to 5 mm. in breadth, as recommended by Frank in Cologne, in the *Centralblatt für Gynäkologie*, No. 9, 1882. The result this time was so good that the patient was able to hold 500 c.c. of urine and was completely relieved of the trouble.

Pawlik cured a case of incontinence, remaining after the closure

of a large vesico-vaginal fistula, by excising a wedge-shaped piece on one side of the urethra extending a short distance up into the vagina. The wound was brought together by sutures, and after it had thoroughly healed a similar operation was performed upon the opposite side. The result of both operations was to pull the urethra out flat by tension on its two sides and to produce a distinct bend in the urethral canal. (*Wiener medizinische Wochenschrift*, 1883, Nos. 25 and 26.)

Schatz has been able to relieve incontinence by the use of funnel-shaped pessaries placed within the vagina.

A similar result has been obtained by a glass ball pressing the neck of the bladder against the symphysis pubis.

Partial Dilatation.

Partial dilatation of the urethra, or urethrocele, consists of a diverticulum of the urethral wall encroaching upon the vaginal canal or projecting into the introitus. In this condition there is a prolapsus or hernia of the urethral mucosa, with the formation of a rounded tumor or prominence on the vaginal surface covered by the vaginal mucosa. This form of urethrocele must not be mistaken for sub-urethral abscess with an opening communicating with the urethra. It is also still more important not to mistake the downward displacement and rolling out of the lower part of the anterior vaginal wall for a urethrocele. It is a common mistake of many gynecologists to call all these misplacements of this portion of the vagina, urethrocele.

The treatment is by excision of a wedge-shaped piece over the dilated portion, removing the surplus tissue, including the whole thickness of the septum. The edges of the wound are brought together by silkworm-gut sutures, and a catheter is retained in the canal for three or four days.

Urethro-Vaginal Fistula.

Fistula affecting the urethro-vaginal septum, and establishing a communication between the urethral and vaginal tracts without involvement of the bladder, is rare.

Such fistulæ may arise from slough due to prolonged pressure during labor, or from a buttonhole operation by which the communication has been artificially established for the purpose of relieving a urethrocele, or so-called hemorrhoidal condition of the mucosa, or on account of a tight stricture of the urethra.

In one instance I observed a fistula resulting from pressure, in which the small oval opening lying just in advance of the neck of the

bladder was closed by silkworm-gut sutures after freshening of its margin, in the same manner as in vesico-vaginal fistula. The sutures in this case were placed transversely.

In another of my cases there was a urethro-vaginal fistula about a half-centimetre in advance of the neck of the bladder, and immediately behind it a vesico-vaginal fistula about 2 cm. in diameter. The anterior part of the urethra was entirely uninjured. The procedure in this case, which was a peculiar one, was entirely successful. The tissue at the neck of the bladder was not sufficient in amount to allow a double denudation on anterior and posterior surfaces, necessary to close the vesico-vaginal and urethro-vaginal fistulæ in the ordinary way. The following procedure was therefore adopted: The bridge of tissue forming the neck of bladder was disregarded, and the oval denudation made to include both fistulæ as if they were one. The edges of the wound were brought together by silkworm-gut sutures passed antero-posteriorly. The result was that urine discharging from the bladder could pass either above the bridge of tissue into the internal orifice of the urethra, or below it, by a short circuit into the upper urethra. There was no incontinence as a result of the operation.

Inflammatory Affections of the Urethra.

Inflammation of the female urethra is a disease of much greater frequency than is usually suspected or diagnosed. The explanation of this lies in the fact that patients complaining of characteristic inflammatory symptoms are not often subjected to a painstaking endoscopic examination.

Numbers of cases of urethritis are diagnosed from their symptoms as cystitis and persistently treated as such for long periods of time. I have at present under my care a patient who was treated in a hospital for some months for irritable bladder, where examination revealed the fact that she had an inflammatory disease limited to the anterior part of the urethra and a small area near the internal orifice.

Inflammation of the urethra is due to infection, and must be discriminated from hyperæmia due to a mechanical or chemical irritant.

The most common cause of inflammation is the gonococcus. In the aggravated form of gonorrhœal inflammation of the urethra, ulceration may also be present.

The urethra may also be the seat of syphilis, tubercular ulcers, and diphtheritic patches.

A mild form of urethritis not infrequently exists in women where there has been no opportunity for infection by contagion, and where there can be no suspicion of gonorrhœa. The disease is apt to be most

marked in the anterior and posterior parts of the urethra. The mucous membrane becomes swollen and deep-red, and the vessels are injected. Upon examination, unless the speculum is handled with extreme care, the mucosa is injured and a little bleeding results. The glands of the urethra stand out prominently, appearing as oval yellow spots a few millimetres long. In the anterior part of the urethra a little secretion is often discharged from one of the crypts, as it comes into view in the lumen of the speculum. This looks like pus, but may be nothing more than epithelial débris. The tenderness throughout is very marked.

Treatment of this form of trouble is both simple and satisfactory. The inflamed parts are touched once in four or five days with a weak solution of nitrate of silver, usually not more than three per cent. in strength. From five or six to a dozen applications will usually clear up the trouble.

In *gonorrhœal urethritis*, the mucosa of the urethra becomes so swollen that there is no longer room for it in the urethral canal, and it pushes down and prolapses at the external orifice, where it pouts out of a deep red color, at a later stage to be bathed in pus. The parts are so exquisitely tender that they cannot be handled, much less can a speculum be introduced, without anæsthesia. Bleeding is often spontaneous and is sure to occur upon the introduction of an instrument. An examination of the secretion under the microscope shows gonococci. The urethral ducts described by Skene are often involved, and, long after the disease has subsided in the rest of the urethra, may remain in the state of chronic inflammation, secreting pus. This pus, as has been pointed out, may become the source of repeated relapses by reinfecting the mucous membrane after the disease has been cured elsewhere, in a manner entirely analogous to the similar inflammation of the ducts of Bartholini's glands. It is important, therefore, always to watch for this complication, and in cases which have survived an attack of specific urethritis, to investigate the condition of these glands. This is done by milking their contents down through the orifice opening into the urethra, while pulling the urethral orifice open and exposing the duct. The anterior vaginal wall just under the symphysis is stroked downward on one side from a point about three centimetres to the inner side of the urethral orifice. The position of the finger in thus emptying the ducts is shown in the illustration (Fig. 86). The appearance of the urethral orifice with a drop of pus on one side issuing from the right duct is drawn from life and is entirely characteristic.

The treatment of gonorrhœal urethritis is by rest, hot vaginal douches, the application of lead-water and laudanum to the external

parts, if swollen and tender, and the administration of such remedies as are used in the male, together with sedative suppositories if necessary.

In the more chronic condition, the passage of a No. 10 speculum and the application once every five to seven days of a two- to three-per-cent. solution of nitrate of silver to the part most affected will be

FIG. 86.—Expression of Pus from the Urethral Ducts.

of great benefit. The general supporting tonic treatment of the patient must also not be forgotten.

SUB-URETHRAL ABSCESS.

I desire under this subject to call attention to a curious affection of the urethro-vaginal septum, whose etiology is still obscure.

An abscess is found in rare cases distending the urethro-vaginal septum and projecting down into the lumen of the vagina. It varies from the size of a small nut up to that a hen's egg. It is well defined, rounded, and extremely tender to the touch, and is often associated with painful micturition and the intermittent discharge of pus from the urethra. Coitus is extremely painful. The examination is best made under anæsthesia, as the patient shrinks from the slightest touch. On pressing on the tumor pus escapes from the urethra and the tumor sensibly diminishes in size.

In a case of my own, described in the *Johns Hopkins Hospital Bulletin*, April, 1894, the patient was colored, 31 years of age, married, and childless. Sexual relation was painful from the first. For four years she had noticed a small lump in the vagina, and an occasional discharge of pus from the urethra during the intervals between micturition. An ovoid mass, 3 by 2½ cm. in size, was found under the urethra (see Fig. 87), pressure upon which caused the escape of pus from the urethral orifice. The urethroscope showed a little depression in the urethral floor a short distance from the internal orifice. A probe was inserted at this point, and on making pressure on the vaginal side, pus was seen oozing through the opening. The relations of the parts are shown in the diagram (Fig. 88).

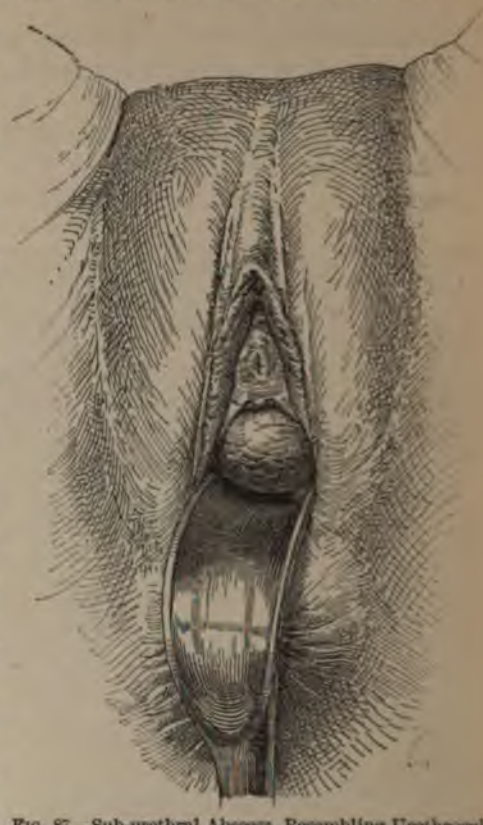

Fig. 87.—Sub-urethral Abscess, Resembling Urethrocele.

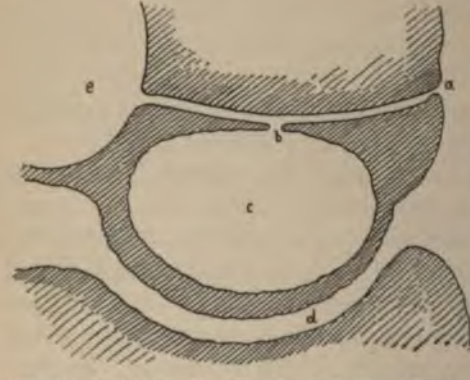

Fig. 88.—Sagittal Section Showing Relations of Sub-urethral Abscess to Urethra and Vagina and its Avenue of Discharge per Urethram.

Various explanations have been offered as to the cause of this trouble which it will not be necessary to discuss here. I believe the probability is that the abscess is due to the infection of Skene's ducts, with closure of the orifice and subsequent perforation of the floor of the urethra, as in the formation of an abscess of Bartholini's gland.

The treatment is either by incision extending throughout the whole extent of the

sac, packing with gauze, and keeping the incision open until it closes by granulation; or by excision removing an elliptical piece of the vaginal mucosa and carefully dissecting out the whole cyst wall down to the urethra, which is left intact, followed by immediate closure of the wound by silkworm-gut sutures.

Calculus.

Calculus of the anterior vaginal wall of a woman, aged sixty-seven, is described by Cheron in the *Gazette des Hôpitaux*, 1887. Cheron opened the sac projecting into the vagina with a galvano-caustic loop, and removed a stone weighing twenty grams. This urethral calculus appears to have arisen from a small renal calculus lodging in the urethra.

Piasecki (*Nouvelles Archives d'Obstetrique et de Gynécologie*, May, 1892) describes the case of a patient, aged sixty-five, who had been suffering for twenty-five years with pain and frequent micturition. He found a tumor as big as a nut, containing a phosphatic calculus, in the posterior urethral wall. The tumor was removed by incision through the vagina.

New Growths of the Female Urethra.

The portion of the urethra which is more liable to be affected by new growths is the external meatus.

At this point we may meet with condylomata, vascular outgrowths, called urethral caruncle, mucous polyps, carcinoma, and sarcoma.

Condyloma.—Condylomata are little warty growths generally found in association with similar disease of other parts of the external genitals, of a pale color, more or less pedunculated, and not sensitive or bleeding readily. Their microscopic characteristics are those of the condylomata elsewhere. They may be snipped off with scissors and the base touched with galvano-cautery to check hemorrhage.

Caruncles.—Urethral caruncle is a disease of the external meatus involving one or both lips; it appears as a deep raspberry red tumor, projecting well beyond the lumen of the urethra, exquisitely sensitive, and bleeding readily upon touch. These tumors are made up of connective tissue and an extensive network of blood-vessels. Their sensitiveness is often so extreme as to cause the patient the greatest agony in passing urine. It is not yet precisely known to what the sensitiveness is due, whether to unusual nerve supply, or to the baring of the nerve endings by the destruction of the epithelium on the surface.

The treatment of this affection is by excision of the tumor at its

base, under cocaine anæsthesia, bringing together the edges of the wound by the finest silk suture. The galvano-cautery has been used, but is unsafe where the disease is extensive, as it is liable to be followed by a cicatricial contraction of the urethral orifice.

Polyps of the Urethra.—Delfosse (*Revue d' Obstetrique et de Gynécologie*, 1892) reports a case of a patient twenty-five years of age who suffered violent pains in urinating. On inspection he found numerous little tumors at the urethral orifice, and with the urethroscope discovered that the whole urethra was covered with small polyps. He removed these with the curette, which occasioned but little loss of blood. The pain had disappeared by the fourth day, and four months later there was no return of the disease.

Concretions have been observed in the urethral glands of the female, analogous to the prostatic concretions in the male.

Carcinoma.—Carcinomatous disease may affect the urethra by extension from the surrounding parts, such as the cervix or the external genitals. Primary carcinoma of the urethra is extremely rare. Cases of cancer affecting the vestibule and so rapidly involving the urethra have been described. Patients affected with carcinoma present no specially characteristic symptoms. The urethral orifice is found to be the seat of a tumor which appears red, bleeds easily, erodes and breaks down in places, and is not tender to the touch. The proliferation of tissue and the breaking-down may be so marked as to leave no doubt at any time as to diagnosis.

The *treatment* of the disease will depend upon the stage at which it has been discovered. If a patient has applied early for treatment, while the disease is still limited to the neighborhood of the external urethral orifice, it may be excised, a wide margin of tissue being removed on all sides. When the affection has travelled up the urethra to the bladder, and there is some surrounding infiltration, operative procedures will be of no benefit.

Sarcoma.—Sarcoma of the urethra has been described by Beigel. The tumor was the size of a walnut, situated on the margin of the urethral orifice. It contained numerous spaces with colloid material. The treatment was by extirpation.

DISEASES OF THE FEMALE BLADDER.

Apart from the inflammatory troubles, diseases of the bladder in women are rare; this is due to its concealed position, behind the symphysis pubis and protected by the strong bony walls of the pelvis. Neoplasms of the bladder wall are particularly rare, in which respect this viscus presents a marked contrast to the uterus immediately ad-

joining. The most frequent affections are hyperæmias, especially of the triangular area, and cystitis. The female bladder is quite liable to fistulæ, an affection but rarely found in the male. Foreign bodies of various sorts are also found in the female bladder much more often that in the male.

Congenital Anomalies.

Fissure of the Anterior Wall.—The most frequently observed congenital anomaly of the bladder is a fissure in the anterior wall. This is produced by defective union of the right and left halves of the body in early embryonic life, and varies in degree all the way from a failure in the development of the anterior urethral wall to a fissure involving the lower part of the anterior bladder wall, or one extending up the anterior abdominal wall a variable distance, reaching as high even as the umbilicus.

In the mildest form of this defect, in which the anterior urethral wall alone is involved, there is incontinence of urine, the clitoris is divided into right and left halves, but there is no separation of the symphysis pubis. In two cases related to me by Dr. C. P. Noble, of Philadelphia, the other genital organs were normal.

In the more extensive cases involving the anterior wall of the bladder there is often an eversion, or exstrophy, of the bladder walls through the opening. In these cases the ureteral orifices may readily be seen with the urine discharging intermittently from them. The ureters are frequently found to be dilated.

I will briefly indicate the line of treatment without going into detail. Where there is a simple slit-like defect, the sides of which can be approximated without difficulty, the appropriate operation is a denudation of the margins of the openings and approximation by suture. Where the defect is more extensive, and a urethra exists, the best plan of treatment will be by sliding flaps, taken from the neighboring portions of the abdominal walls, over the exposed portion and uniting them by their edges.

Double Bladder.—Cases of division of the bladder into two halves are exceedingly rare, and as a rule found only in very young children. The only adult case on record is that related by Gerard Blasius, of Amsterdam, in his "Observationes Medicæ Rariores," published in Amsterdam, in the year 1700. His eighteenth observation, on page 59, is as follows: "A divided urinary bladder. Second case. Seen on the tenth of January, 1657, at the post-mortem examination of a patient who died of phthisis. The exterior of the bladder exhibited simply a depression throughout its length, but the interior was divided into two cavities by a thick membrane

extending down to the urethra, into which each cavity emptied. Each cavity was provided with but one ureter. It was possible by dissection to separate the bladders completely." The condition found is well shown in his twelfth figure on page 114.

Other cases similar to this are those in which vertical septa are found dividing the bladder less completely.

Displacements of the Bladder.

Displacements of the bladder may be conveniently considered under four headings: (1) Displacement upward; (2) Descensus or partial displacement downward; (3) Extreme displacement downward of a portion of the bladder; (4) Ectopia, or eversion.

None of the displacements above referred to, except the last, is a disease of the bladder *per se*. The upward and downward displacements are due to the traction or pressure of tumors, or are associated with a prolapse of vagina and uterus. Displacements dependent upon the growths of tumors, or alteration in position of other organs which may be progressive, are liable to vary in degree with the changing positions of these organs, and are corrected when the associated causal trouble is removed.

Upward Displacement of the Bladder.—This dislocation is most frequently observed in cases of large myomatous uteri, in which the tumors develop under the pelvic peritoneum and spread out into the broad ligaments, and as they develop upward carry the bladder along with them.

The *treatment* in these cases must be directed to the removal of the tumors, by means of which the bladder is let down to the pelvic floor to, or even below, its normal position.

Descensus, or Partial Displacement Downward of the Bladder.—This difficulty is observed in cases in which the vaginal outlet is broken down and there is a tendency toward prolapsus uteri, as is seen in a descent of the cervix toward the vaginal outlet, together with a dropping down of the anterior vaginal wall, filling the opening. On account of the association of the bladder with this displacement of the anterior vaginal wall, the protruding mass is commonly called a cystocele. Much time has been unnecessarily wasted in discussions of cystocele, and the analogous affection of the posterior vaginal wall—rectocele. It is important to recognize the fact that these are not affections *per se*, but symptomatic merely of a condition of the vaginal outlet.

Treatment.—I have long since given up operation upon either cystocele or rectocele alone. Where the relaxation of the vaginal outlet

is not marked and an operation is not indicated, a well-fitting Hodge or Gehrung pessary, especially the latter, will serve to lift up the anterior vaginal wall and relieve the bearing-down discomfort. The most complete relief will be obtained by a suitable operation upon the relaxed vaginal outlet, restoring it to its normal size and position under the symphysis pubis, thus building up the posterior vaginal wall again, and giving the vaginal canal its normal direction backward and inward toward the lower part of the sacrum. This gives support to the anterior vaginal wall and effectively relieves the cystocele.

Extreme Displacement Downward of a Portion of the Bladder.—This form of displacement is found associated with prolapsus uteri. Its occurrence is due to the intimate union between the bladder and the supra-vaginal portion of the cervix, which is so closely attached to it that, as the uterus escapes from the pelvis, all this portion of the bladder must of necessity pass out with it, forming a large diverticulum on the anterior face of the prolapse. By passing a sound through the urethra, which has changed its direction in the manner described above (p. 697), the lowest part of the diverticulum will be found to lie just above the cervix uteri at the most dependent part of the sac. By passing the sound in an opposite direction, a portion of the bladder will also be discovered occupying the pelvic cavity above the uterus. When distended the bladder forms a bilobate organ, of which the outer lobe can be distinctly felt to fluctuate upon touch.

Women suffering from prolapse always find difficulty in emptying the bladder, and unless the prolapsus is returned each time, evacuation is never complete. The presence of the diverticulum predisposes to cystitis, if infectious material once finds its way into the bladder. Large numbers of calculi may also form in the sac.

The *treatment* of the condition is the same as that for prolapsus uteri. The operation devised for the relief of prolapsus must therefore be considered not simply as an operation for the retention of the uterus within the pelvis, but equally for the permanent correction of the displacement of vagina and bladder. Where the radical plan of retention by denudation and suture is out of the question, it may be effected by a series of buried silkworm-gut sutures encircling the vagina from the cervix down to the outlet, narrowing and stiffening the vaginal canal in such a manner as to render prolapse impossible. This is the plan recommended by Freund of Strassburg (*Centralblatt für Gynäkologie*, No. 47, 1893).

Ectopia of the Bladder Without Fissure.—Three cases of prolapse of the bladder through the urethra are cited in an article by Lichtenheim (Langenbeck's *Archiv für klinische Chirurgie*, Bd. XV.). The

displacement occurred at the lower part of the abdomen, where the symphysis pubis was separated. The tumor protruded in the form of a bright-red mass, which was easily returned through the defect in the lower abdominal wall. There was no defect in the bladder wall, and therefore the retention of urine was not interfered with. The color of the tumor was due to its investment with a membrane presenting the characteristics of the mucous lining of the bladder.

Another kind of prolapse of the bladder is that in which it is forced through a lax urethra and out through the external urethral orifice, where it appears as a large, bright-red mass. On its under surface the ureteral openings are seen. One case of this kind together with prolapse of vagina and rectum has been observed in consequence of a fall (v. Winckel in Billroth and Luecke's "Handbuch der Frauenkrankheiten," Bd. III., p. 421, 1886).

Vesico-Vaginal Fistula.

Vesico-vaginal fistula, or the establishment of an accidental communication between the bladder and the vagina by means of a defect in the base of the bladder, is not infrequently met with in two classes of cases. First, those in which a cancerous disease extending from the cervix uteri, and involving the vesico-vaginal septum, has broken down and formed an avenue of communication; second, those in which a protracted labor has been followed by sloughing of the anterior vaginal wall during the puerperal period. They are also rarely seen as a result of an unhealed incision of the vaginal wall for the extraction of stone. The cancerous cases are not amenable to treatment and will not therefore be further mentioned; the mode of death is by progression of the disease, pressure upon the ureters, and uræmia.

Fistula following Labor.—Vesico-vaginal fistula may follow labor from a number of causes. Without doubt the most common cause is prolonged pressure of the head of the child in one place, in consequence of which the circulation is completely cut off and the tissues bruised; in the course of five or six days or a week a slough more or less neatly punched out of the vesico-vaginal septum falls into the vagina and leaves the fistula. Women with contracted pelvis, or with a sharp bony growth on the posterior surface of the symphysis, are more liable than others to this affection.

It has been the habit in the past to blame the use of the forceps in difficult labors for the production of this trouble, but as Emmet long since pointed out and repeatedly insisted upon, it is not the use of the forceps, but a want of their timely use to relieve the pressure, which is to blame.

Vesico-vaginal fistula also arises in consequence of a tear through the anterior lip of the cervix extending out into the vaginal vault, and up through the whole septum. This tear also usually extends into the uterus, forming a vesico-utero-vaginal fistula. Not infrequently nature will unite the lips of the cervix below, leaving a vesico-uterine fistula above and a vesico-vaginal fistula beneath, separated by a bridge of uterine tissue. The clinician must be careful to interpret these cases aright, recognizing the fact that the two fistulæ were originally but one. Fistulæ of this character may be the direct result of an anterior median tear produced by the forceps.

Vesico-vaginal fistulæ vary greatly in size as well as in their associated complications. The fistula may be so large as to include the whole base of the bladder. On examination, the upper wall of the bladder, red and easily bleeding, is seen hanging down into the vagina, looking like an intense inflamed anterior vaginal wall, often more or less œdematous. Other fistulæ present an irregular but generally rounded outline, and occupy any part of the base of the bladder; they are of all sizes, down to an opening as fine as a hair.

It is rare that a woman will pass through a difficult labor, resulting in fistula, without other serious injuries to the lower genital tract. In these cases we often meet with extensive deposits of cicatricial tissue in the vagina, extremely narrowed cicatricial vaginal orifice, distortion of the margins of the fistula by the vaginal cicatrix, and the pinning down of a portion of the fistula to one of the pubic rami by scar tissue. A patient now under my care presented a complete atresia at the vaginal vault with retention of the menstrual secretions in the uterus; a vesico-vaginal fistula lay in front of this big enough to admit the thumb, and directly opposite the vesico-vaginal fistula, on the posterior wall, a recto-vaginal fistula equally as large was found.

The *diagnosis* of vesico-vaginal fistula is usually easy. There is a constant discharge of urine, although the operator must not be misled by the statement of the patient that she is able to retain it for some time when lying down. This is due to the fact that a vagina will retain considerable urine in this position. The urine held in this way escapes on arising, but the patient cannot always distinguish between such a mode of discharge and a discharge per urethram. Upon inspection of a patient with a large fistula, the hole in the bladder wall is very conspicuous, and the fact of the communication is easily demonstrated by a sound passed through the urethra and bladder into the vagina. A smaller fistula may be more difficult to find and may require the aid of an injection into the bladder of sterilized milk, which will then be seen escaping, drop by drop, from the minute fistulous orifice, or if the fistula opens into the uterus,

from the cervix. When the patient is placed in the knee-breast position, the bladder fills with air and its walls drop away from the fistula, through which a large part of the bladder can be inspected, if the opening is large. Smaller openings examined through the cystoscope introduced per urethram are often difficult to detect on account of their lying in the plane of vision. When located, the fistula can be made to appear more distinctly by pushing up the bladder wall with the end of the speculum and bringing the opening directly across it.

Treatment.—Many of these fistulæ occurring post partum contract down and close spontaneously. We are in a position to appreciate the ease with which this may occur in uncomplicated cases, from our experience with the difficulties in keeping open a fistula created artificially for draining the bladder for cystitis.

All those cases which do not close spontaneously call for operative treatment, which consists by one device or another in uniting the edges of the bladder in such a manner as to close the defect with the least possible tension and without injury to the ureters.

It is not long since Dr. J. Marion Sims closed these fistulæ exclusively with silver sutures, and believed that the success in their treatment was chiefly due to the special form of suture used. Bozeman and Emmet have laid the greatest stress upon the preliminary preparation of complicated cases, by incising scar tissue and dissipating it by pressure. The tendency to-day, however, is in almost all cases to proceed at once with the repair of the defect.

Dr. Nathan Bozeman, of New York (*New York Medical Journal*, Oct. 1st, 1887), urges the use of hard or soft dilators. The former are introduced and left in the vagina, where they are held by an external attachment. The soft dilators are made of strips of sponge covered with oiled silk. By means of the pressure exercised by these dilators scar tissue is stretched and dissipated.

In all cases where the vagina contains necrotic sloughing tissue, where the edges of the fistula and the neighboring parts are raw and granulating, and where incrustations are found at the margins of the fistula and on the vaginal walls, these complicating conditions must be removed before proceeding to an operation for closing the fistula. This will be attained by exposing the parts and removing as much of the dead tissue and incrustation as can readily be taken away, and after this using daily warm irrigations, either solutions of borax or weak carbolic-acid lotions, and every four or five days touching the raw surfaces with a solution of nitrate of silver, varying in strength from three to five per cent.

While thus treating these associated conditions, it will be well also to incise bands of scar tissue in several places, loosening up the

margins of the fistula, or opening up the vaginal canal, so as to make the fistula more accessible. By such preparations a difficult operation will be rendered more easy, and success attained where the result of an immediate operative procedure would have been a failure. I hold, however, that with the improved technique of our operations to-day, the same amount of elaborate preparation, more particularly that dealing with the scar tissue, is not so necessary as in the days of our immediate predecessors.

A skilful operator will not be embarrassed by finding a marked stenosis of the vaginal orifice, for this can be at once extensively divided with the knife, on one or both sides, carrying the incision down beside the rectum, giving all the room necessary to get at the fistula. Scar tissue radiating out from the edges of the fistula can also at the time of operation be freely incised, or even cut out entirely, with the result of loosening up the margins of the fistula so that they can be approximated.

In one of my cases, the edge of the fistula was pinned down to the left descending pubic ramus and was extremely awkward to get at, besides leaving no room for applying sutures on the side of the scar. I overcame this difficulty successfully by introducing a delicate sharp lance on the vulvar surface about 3 cm. (1¼ in.) distant, and carrying it along under the mucous membrane freed in this way the margin of the fistula from the bone without puncturing it. The hemorrhage from the little opening made by the lance gave no trouble. The fistula was then successfully closed.

Where the fistula is of moderate size, 2 cm. in diameter or smaller, and its edges can be approximated by traction, the best plan of procedure is a denudation of its margins on all sides bevelled from the vaginal surface down to the mucosa of the bladder. It is not necessary to remove more than the very edge of the mucous membrane. On the vaginal surface, however, the denudation must be from 5 to 6 or 8 mm. in width. If the fistula is small and round, not more than 2 mm. in diameter, the denuded surface has a distinctly funnel shape. When the fistula is larger the denudation simply exaggerates the shape of the fistula.

The sutures must be passed in such a manner as to bring the margins of the fistula snugly together with the least possible resistance. In general, it is easier to pull the upper part of the vagina down into apposition with the lower part than to attempt to make up a large defect by pulling together the wound surfaces from side to side.

Too great care cannot be observed throughout to avoid catching the ends of the ureters in the sutures. The consequence of such an accident is uræmia. If the symptoms of such a condition were dis-

covered in time the sutures would have to be cut immediately. Such an accident may be guarded against by carefully locating the position of the ureteral orifices, and also by not passing sutures too deeply so as to include too much tissue.

For the smaller fistulæ either silk or silkworm-gut sutures may be used; for the larger the best sutures are deep silkworm-gut, with superficial silk sutures between them.

The easiest way to pass the sutures is by a needle threaded with a carrier. The needle is entered about 3 mm. from the margin of the wound on the vaginal surface, and brought out on the vesical margin without penetrating the mucosa; it is re-entered on the opposite side on the vesical margin, and brought out again on the vaginal surface. After several sutures have been introduced in this way, about 5 mm. apart, they may be tied, and others introduced in the same way and tied, and so on until the whole fistula is closed. It is not necessary to tie them very tightly. Each suture should bring the margins of the wound neatly and snugly together. Between these deeper sutures superficial sutures of finer silk are passed for accurate approximation on the surface. An iodoform gauze pack is now placed in the vagina and a soft catheter laid in the bladder through the urethra to drain the urine for the first five days. To avoid irritation from the catheter, it is better to leave it out for a while in the morning and again in the evening. After the fifth day, the patient may be catheterized every three or four hours for three days longer, after which she may void urine. The stitches may be removed from the fifth to the tenth day.

Ability to retain a quantity of urine always increases as the bladder grows accustomed to resuming its functions.

I have ventured with success in some of the smallest fistulæ to dispense entirely with the use of the catheter, and to allow the patients from the first to empty the bladder when they felt the inclination.

Dr. A. Martin, of Berlin (*Zeitschrift für Gynäkologie*, 1891), describes a method of healing a large fistula after numerous other attempts had failed, by dissecting a flap off from the vagina and filling out the defect with that.

Prof. H. Fritsch, of Breslau (*Centralblatt für Gynäkologie*, 1888, No. 49), recommends a flap method of closing fistulæ by splitting the margins of the wound enlarged by an incision passing through the centre of the fistula and for some distance beyond on either side. When the fistula is small, the fistulous tract itself must be dissected out in such a way as not to make the wound margins uneven. He looks upon the method as especially serviceable where the fistula is attached to the bone.

One of the most remarkable operations for large vesico-vaginal fistula was that performed by Dr. E. C. Dudley, of Chicago, upon a woman who had lost so much of the base of the bladder with the anterior vaginal wall, that it was impossible to close the fistula in the ordinary way. Dr. Dudley completely relieved the woman by one operation, in which he freshened a strip on the mucosa encircling the inside of the bladder. He then folded this line of denudation on itself and sutured with silver wire, in such a way as to divide the bladder into two parts, an upper closed sac communicating with the urethra and receiving the urine from the ureters, and a lower open portion, replacing the anterior vaginal wall.

The following plan for the treatment of the larger vesico-vaginal fistulæ has been recommended by A. Mackenrodt of Berlin (*Centralblatt für Gynäkologie*, No. 8, 1894). The cervix and the urethral prominence in the vagina, the upper and lower limits of the fistula when it extends so far, are caught by bullet forceps, and the anterior vaginal wall is put on the stretch by traction upward and downward by the forceps. If the uterus is prevented from coming down, the scar tissue holding it back is cut through. An incision is now made through the tense anterior vaginal wall from urethra to cervix, passing through the fistula. The edge of the fistula is now split on all sides and the anterior vaginal wall freed from the bladder. The bladder is also separated from the uterus high up, so as to release the wall of the bladder as far as possible in front and behind. The margin of the fistula opening in the bladder is now freshened on all sides and united with fine silkworm-gut sutures close together. Over this layer of sutures a second and even a third layer may be passed, turning the bladder wall in upon itself.

After thus completely closing the bladder, the opening into the vagina is denuded and the body of the uterus pulled down (as in the operation for vaginal fixation) and attached to the anterior vaginal wall, the vaginal margins being brought together as completely as the defect will allow. Where approximation is impossible the uterus is united to the sides by a number of interrupted sutures.

Dittel has recommended (*Wiener klinische Wochenschrift*, 1893, No. 25), as a method of closure in difficult cases, an incision through the abdominal wall exposing the vesico-uterine pouch, a transverse incision freeing the bladder from the uterus and then from the vagina, until the fistula is exposed. The hole in the bladder is now sewed up, the peritoneal surfaces again united, and the abdomen closed. The opening in the vaginal wall is not closed but drained by means of a strip of iodoform gauze.

The closure of vesico-vaginal fistulæ by buried sutures was recom-

mended by Vulliet, in Geneva (*Nouvelles Archives d' Obstetrique et de Gynécologie*, 1887, Nov. 25th), and practised in a case where a patient had been already three times operated upon. The margins of the bladder wound were denuded and united with a continous suture, after which the vaginal surfaces of the wound were brought together in like manner. The sutures used were of silk.

Where the fistula lies close to the cervix, it may readily be closed by making the area of denudation include as much of the cervical tissue, as well as of the neighboring vaginal tissue, as may be necessary to secure broad surfaces of approximation.

Where there is much scar tissue about the cervix, or where the fistula opens into the uterus above, the best plan is to dissect the vaginal vault free from the anterior part of the cervix and to carry the dissection up high enough to release the fistula entirely from its uterine connections, and leave a broad margin of freshened tissue surrounding it on all sides. The fistula may now be closed with buried sutures of fine silk, catgut, or silkworm-gut. The wound surface between the bladder and uterus may now either be closed by sutures or drained by iodoform gauze. In one case of my own, where there was a small vesico-vaginal fistula just in front of the cervix and a vesico-uterine fistula about 1½ cm. above the vault, I closed both by the following procedure: The cervix was caught by a pair of bullet forceps and drawn down, making the vaginal vault tense. The vagina was then dissected free from the cervix anteriorly, and the dissection was carried above the vault until the vesico-uterine fistula was exposed and severed from its uterine connection for about 1 cm. on all sides. The margins of the vesico-vaginal fistula were then denuded. The sutures were now passed in such a manner as to oppose the fistulous orifices one to the other, so that with a single row of sutures from side to side both fistulæ were closed.

Ureteral Fistulæ.

Apart from the conditions already described, a *stillicidium* of urine from the genitals may be seen when there is an abnormal communication between one of the ureters and some portion of the genital tract. The striking peculiarity of these cases is, that, in spite of the constant leakage, urine is passed at regular intervals *per vias naturales*. This is due to the fact that while one ureter is abnormally switched off into the interior genital tract, its fellow still retains intact its connection with the bladder.

Ureteral fistulæ are observed as congenital malformations, in consequence of injuries during labor, from operations about the vaginal

vault, such as the incising of an abscess, and after the operation of vaginal hysterectomy. These fistulæ in the past were quite rare, but they have within recent years become much more common because of the great frequency with which the uterus is removed by the vagina for cancerous disease. The explanation of this fact is that the infiltration of the cervix with the new growth makes it much larger, and shortens the distance between the cervix and pelvic wall, consequently bringing the ureter, which lies between, much closer to it. On the other hand, also, the necessity of leaving a pedicle, and the natural anxiety of the operator to give the disease as wide a berth as possible, make it remarkable that the ureter is not more frequently involved than it appears to be from published reports.

The *diagnosis* of ureteral fistula will be made by noting: first, that although there is a constant escape of urine, the patient still passes urine at regular intervals; second, that upon injection of sterilized milk into the bladder none of it escapes through the vagina, while the urine still escaping from the vagina continues clear; third, that by placing the patient in the dorsal position with elevated pelvis, or in the knee-breast position, the ureters may be catheterized as described, and urine collected from one side while no urine escapes from the other; fourth, that the sound may be readily entered into one ureter and passed back to the posterior wall of the pelvis, while in the other it cannot be pushed in more than a few centimetres; fifth, in the congenital malformation where there is a double ureter on one side with one of its openings near the urethra, and the other in the bladder, the evidence that the fistula is not vesical will be obtained by the injection of milk. The catheterization of both ureters will demonstrate also that they are pervious and functionally active. It may also be possible to pass a bougie into the abnormal orifice and push it up through the pelvis behind the abdominal cavity.

The *treatment* of ureteral fistula is by turning the abnormal orifice into the bladder by either a vaginal or an abdominal operation. Where there is sufficient room to work in the vagina, and the ureter is long enough to be dissected out and turned in through a slit made in the base or posterior wall of the bladder, the vaginal route is to be preferred. If, on the contrary, the fistula is up in the uterus or is hidden behind scar tissue of the vaginal vault, the better plan will be to open the abdomen and dissect the lower 3 or 4 cm. (1 or 1½ in.) of the ureter loose from its attachments. Then sew the ureter into the small opening made into the bladder at the nearest point, with a series of delicate circular sutures. The ureter thus attached must project a slight distance into the cavity of the bladder.

I performed this operation in the fall of 1894, upon a woman who had been operated upon by my assistant some weeks before, for cancer of the cervix. The right ureter had been cut off in the operation, and was draining through the scar tissue into the vaginal vault. After demonstrating on which side the injury lay, by the cystoscopic examination and the sound, the abdomen was opened, and the ureter dissected out of its bed. The ureter thus lifted up was too short to reach the bladder, which was therefore dissected loose from its pelvic wall attachments, anteriorly and laterally and dropped back to the ureter. The ureter was then sutured into a small opening made in the posterior vesical wall. To avoid tension upon the bladder, in closing the abdomen the lower part of the peritoneal incision was not drawn together. The abdominal wall was closed throughout. The operation was rendered difficult throughout by the obesity of the patient, but immediate union was obtained and the urine thereafter was discharged normally per urethram.

Stone in the Bladder.

Calculi in the female bladder arising, as in the male, simply from a deposit of the salts in the urine without other provocative cause, are but rarely found. Numerous cases, however, are recorded in which foreign bodies introduced by the patient herself through the urethra, or by a surgeon in the course of an operation, form the basis of calculi which may attain considerable size. All sorts of objects small enough to slip into the urethra have been thus introduced, and afterward found forming the nuclei of calculi. The commonest are catheters, pencils, and hair-pins. Of the latter a number of cases are recorded. The hairs of a dermoid cyst may also form the nucleus of a calculus.

An example of a hair-pin calculus is shown in Fig. 89. This was introduced by the patient, a young unmarried woman, who married a short time afterward. She passed through a confinement without any injury to the bladder, although the calculus had already formed about the pin and was felt by the doctor in attendance, who pushed it up into the abdomen while the head was descending through the pelvis. No explanation could be obtained from the patient as to how the hairpin got into the bladder, but the mother, who saw it after removal, declared that she must have swallowed it.

I have twice removed calculi forming about sutures left in the septum after an operation for vesico-vaginal fistula. The peculiarity of these stones is that they are fixed.

The symptoms of vesical calculus are painful micturition and the various symptoms of the cystitis excited by its presence.

The *diagnosis* is made by inspection, when the calculus will be readily seen either lying free or pocketed in the bladder. It may also be recognized by the sound striking a hard body, and bimanually by catching the stone between the fingers in the vagina and the hand pressing down through the abdominal wall into the pelvis. All methods of examination, however, are inferior to direct inspection after the manner described above.

The *treatment* of stone is by removal in one of the following ways: If it is quite small, not more than 2 to 2½ cm. in diameter, or if it is somewhat larger than this, and quite soft, it may be crushed with a lithotriptor introduced into the bladder filled with water and with the pelvis elevated.

Fig. 89.—Dr. Eccles' Case of Hairpin Calculus.

The old method of dilating the urethra and dragging out the stone ought never to be resorted to for the extraction of rough stones or those exceeding 1½ to 2 cm. (⅝ to ¾ in.) in diameter.

Where the stone cannot be safely removed through the urethra in the manner described, the best avenue of approach to it is by an incision into the base of the bladder in the median line in front of the cervix. This incision can be made from an inch to an inch and a half long, the stone removed through it, and the incision immediately closed again.

Where the stone is so large as to fill the bladder, being 5 or 6 cm. (2 or 2½ in.) in diameter, or even larger, and the patient is in good condition, it will often be better to remove it by a suprapubic operation, making an incision into the abdominal wall in the median line just above the symphysis, pushing up the peritoneum without opening it, incising the bladder, and removing the stone. If there is much cystitis, it will be better not to close the wound entirely, but to suture the bladder wound and insert a gauze drain above this in case of infection and breaking down of the incision.

Cystitis.

It is impossible at present to estimate the frequency with which cystitis occurs in women. Severer grades of cystitis are not infrequently met with, and milder degrees of the affection seem to become more frequent as cases are examined by the new cystoscopic method.

All grades of inflammation of the bladder mucosa are found, from a slight hyperæmia well localized, through hyperæmic conditions distributed in patches over the surface of the bladder, to an intense inflammatory state involving the whole surface of the mucosa. While we cannot properly speak of the hyperæmias as inflammatory clinically, we observe all grades of them from a mild congestion to a well-defined inflammation.

The *cause* of the inflammation is one of the pus-producing organisms, or it may be a diphtheritic affection, or tuberculosis. Affections of the latter class have proven, in my experience, to be quite common. In several instances, the tubercular cystitis was associated with a tubercular ureteritis. In another case a tubercular inflammation was localized near the right posterior cornu of the bladder. I was able here to discover by a cystoscopic examination that the focus of the bladder trouble was about a small orifice which a careful bimanual pelvic examination showed to be connected with a densely adherent right tube and ovary, undoubtedly tubercular, and pouring pus through a sinus under the broad ligament into the bladder.

Morbid Anatomy.—The changes in cystitis are quite characteristic, the most marked being the reddening of the surface, more or less intense according to the grade of inflammation, and varying in degree with the extent of contraction of the bladder. As the inflammation becomes more marked the larger vessels, so characteristic of the normal background, disappear from view. Sometimes a network of innumerable capillaries may be seen, at others nothing more than an intense red blush on the surface. In a graver class of cases the mucous membrane breaks down in places and discharges in flabby shreds mixed with pus. These can be seen hanging from the sides of the bladder, overlying areas of granulation tissue, floating in a little bloody urine, accumulating in the vault (when the patient is examined in the knee-breast position), and hanging from superior to inferior wall like beans. In these cases, to get a clear picture of the actual state of the bladder, it will be necessary to introduce a two-way catheter and to give it a thorough washing out. Oftentimes the bladder walls are so coated with a deposit of dark blood as to be invisible. This may come down from the kidneys and settle on the mucous membrane, or may arise from hemorrhage of the bladder

wall. It is usually found in those parts of the bladder which are most dependent when the patient is lying down or sitting. A little pledget of cotton introduced on the mousetooth-forceps will remove the thin layer of blood and expose the surface beneath it.

At the first examination of a case of cystitis, it is in the highest degree important to make a minute inspection of every part of the bladder, not forgetting the urethra, when the speculum is withdrawn at the conclusion of the examination. Particular attention must be paid to the ureteral areas. The results of the examination should also be entered upon the schemata which I have described in the section on the topography of the bladder.

The *treatment* of cystitis is general, systemic, and local. Patients thus afflicted should go to bed and keep as quiet as possible. The bowels must be kept thoroughly open, and a mild, non-stimulating diet prescribed. Sweet spirit of nitre given in half-teaspoonful doses, four to six times daily, often diminishes the pain. Hot vaginal injections are serviceable as a counter-irritant, and benefit is often derived by the use of hot-water bags over the abdomen. The most direct and best form of local treatment is by injections of a few ounces of 1–100,000 bichloride solution repeated daily. While the patient at first is able to retain only a few ounces, she will often soon be able to hold four or five. The strength of the solution can be increased by taking off 5,000 each time, until it is equal to 1–20,000 or 1–30,000. Where the bichloride is not well tolerated, a good result may often be obtained by injections of a saturated solution of borax in water, once daily.

Where the cystitis is localized in patches, the improvement will often be hastened by applications once in five days, or once a week, of a three-, five-, or even ten-per-cent. solution of nitrate of silver, directly upon the affected area. This application must of course be made through the cystoscope, and be controlled by sight. It will not do good, but rather harm, where the inflammation is widespread and intense.

When the disease has existed a long time, and the patient is suffering intensely, and the whole or almost all the bladder is found to be affected, immediate relief will be given and a cure more quickly realized, by making an opening an inch long into the vagina through the base of the bladder, and suturing the vesical to the vaginal mucosa, to prevent the artificial fistula from closing too soon. The constant, perfect drainage thus secured will give great relief, and in the course of from two to four months will bring about such a degree of improvement that the fistula may be closed and the rest of the cure effected by irrigation.

Exfoliative Cystitis.

An exfoliation of the entire mucous with more or less of the muscular membrane of the bladder has been observed in cases of the retroflexed gravid uterus, usually at about the fourth month. The same accident has been noted after delivery at term and after lifting a heavy weight. In one of my own cases it occurred in a girl of about twenty years after the removal of a large, densely adherent monocystic ovarian tumor.

The disease begins with pain, elevation of temperature, the discharge of fetid ammoniacal urine, often with considerable blood and pus. The loosened membrane may choke the internal urethral orifice, causing temporary retention followed by the sudden expulsion of a large amount of urine.

The membrane is often thrust out through the urethra entire or in pieces consisting of a discolored mucosa with shreds or sheets of the muscularis and more or less covered with crystals of urine salts. In spite of the serious nature of the ailment recovery with powers of retention of the urine occurs in a large percentage of the cases. (See article by Dr. Boldt in the *American Journal of Obstetrics*, Vol. XXI., p. 350; also one F. W. N. Haultain in the *Edinburgh Medical Journal*, June, 1890.)

Hyperæmia of the Vesical Triangle.

I have thus far invariably found, in cases of so-called irritable bladder, where, with more or less pain, the patient has been distressed with frequent micturition during the day, and sometimes by night also, that there exists over the whole or some part of the vesical triangle a marked hyperæmia. As a rule, this is not uniform but distributed in a patch nearer to one ureter. It may be located near the urethral orifice and extend for a short distance down into the urethra. I have invariably found this condition in patients troubled with their bladders after an abdominal operation. A young girl was sent to me from the South suffering from no other complaint than frequent micturition. On examining her I found the whole bladder was sound except this area, where the hyperæmia was very marked. The patient was entirely and permanently relieved by a few treatments with a three-per-cent. solution of nitrate of silver, directly applied, through the endoscope, on a piece of cotton. By this simple means of treatment I have been able to relieve all cases of this character, thus getting rid of a class of complainers who had previously given me much distress. These women may be treated as office patients, and allowed to return home immediately after the application, which is only slightly or not at all distressing.

Ulcer of the Bladder.

I have seen two cases of simple, well-defined ulcer of the bladder, located in each instance in the triangle between the ureters and urethra. One of these patients, a stout, well-built woman, was profoundly anæmic, from excessive vesical hemorrhages. She had for some months been constantly passing large quantities of blood during micturition. The cystoscopic examination showed an oval ulcer with a raw, ragged, bleeding surface stretching transversely across the triangle. A few treatments with nitrate of silver checked the hemorrhages entirely and brought about a complete recovery. There has been no relapse after almost a year.

In the second case, at the apex of the triangle immediately within the urethra, I found, in a stout, healthy-looking woman, a shining white "diphtheritic" patch about 8 mm. in diameter, with thick turned-up edges. This was readily removed from a flat pinkish base, which bled easily but not excessively; immediately surrounding the ulcer, the mucous membrane was deeply injected and œdematous, and projected over its edges. The patient complained of painful, frequent micturition. Under treatment with a solution of nitrate of silver, at first five and afterward three per cent., carefully limited to the diseased area, the diphtheritic membrane has disappeared entirely and the ulcer has contracted down to 2 mm. in diameter.

Neoplasms.

Cancer of the bladder is often observed through extension of the disease from the cervix uteri, but primary new growths of the bladder walls are rare.

The relative frequency of tumors in the male and female affecting the bladder walls primarily has been estimated in the proportion of three to one.

Williams (*British Medical Journal*, 1889) found, out of 90 cases of tumor of the bladder, of which 20 were in women, 16 were carcinomata, 2 papillomata, 1 sarcoma, and 1 fibroma.

The name papilloma is often made to include both benign fibrous growths covered with epithelium more or less branched in form, and growths which show their malignant nature by relapsing into carcinomata or sarcomata.

True papilloma, "dendritic fibroma," appears to originate from a budding of the vesical blood-vessels.

Golding-Bird (*British Medical Journal*, 1889) describes a case of sarcoma originating in the posterior walls of the bladder, re-

moved by suprapubic section with the galvano-caustic loop. The wound was drained by carbolized gauze. The patient died on the fourth day, with infection.

The most characteristic symptom of bladder tumors in the early stages is hemorrhage.

The *diagnosis* is easily made upon inspection with the cystoscope.

The *treatment* will vary according to the nature and size of the tumor. Small pedunculated tumors can be easily caught with a snare like that used for removing nasal polypi. They may be slowly removed in this way, taking several hours if the operator deem it wise on account of the danger of hemorrhage. The patient is returned to bed after the loop of the snare has been placed about the pedicle; the screw is turned to tighten it up every ten or fifteen minutes until the pedicle is cut through. Larger tumors may be removed by vaginal incision in the same manner as vesical calculi. The base may be ligated or closed by sutures, which will afterward be removed through the cystoscope.

Malignant tumors, unless limited in extent and so situated on the base of the bladder as to be readily reached through the vagina, ought to be removed by preference by suprapubic section, through which larger areas of the bladder wall can be extirpated with more precision, and the incised edges brought satisfactorily together.

Professor Pawlik, of Prague (*Centralblatt für Gynäkologie*, 1890, page 113), removed a small pedunculated polypus from the bladder by a vaginal incision. Eight months later the hemorrhages had returned, and an examination revealed an extensive, broad-based papilloma, for which he proceeded to extirpate the bladder. After introducing two metal catheters into the ureters, he freed the terminal extremity of each ureter for 2 cm., and attached it to the vaginal wall, establishing two uretero-vaginal fistulæ. Three weeks later he extirpated the bladder by making a suprapubic incision, without opening the peritoneum, and released the bladder from its attachments. The vaginal wall was then cut transversely, just beyond the urethral prominence, and the bladder drawn through this opening into the vagina and cut off at the internal urethral orifice. An attempt was now made to close the vagina by turning the urethra into it and making a pocket for the urine escaping from the ureters, by uniting the upper margin of the vaginal incision to the anterior urethral wall and closing the vagina below this by a circular denudation and suture. The new bladder formed in this way had a capacity of 400 c.c. The closure of the vagina, however, was not successful.

The most important summary of the literature of this subject will be found in the *Jahresberichte* of Professor Frommel, of Erlangen.

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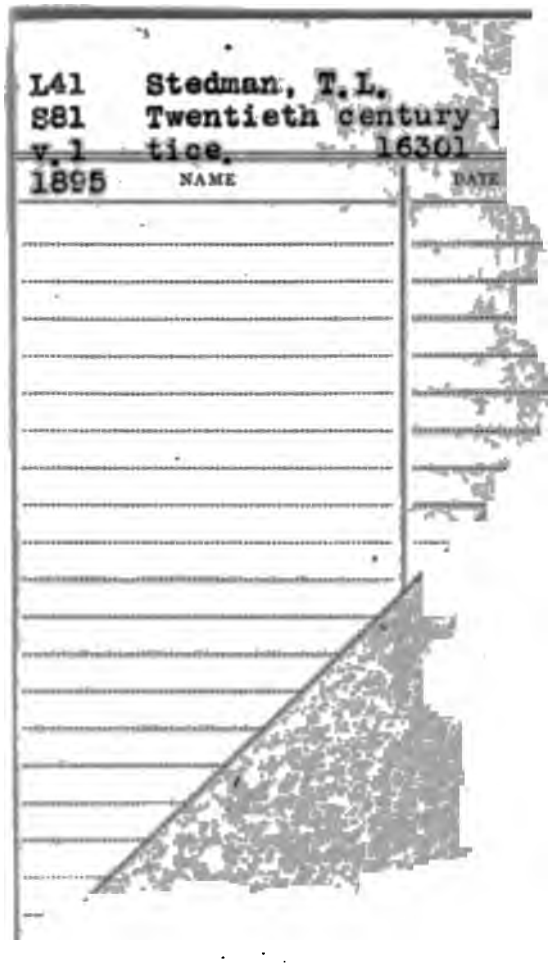
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